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MONDAY—OCTOBER 31

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The Fishing Industry's Attitudes Towards Official Voluntary Quality Standards

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AMONG THE MEMBERS of the United States fishery industry there exists a full range of attitudes towards official voluntary quality standards. A number are enthusiastically confident that such standards would foster general quality improvements and therefore would increase sales. Others actively oppose any type of standards, because they fear the possibility of interference with their normal operations. These two extremes are occasionally the most vocal, but they represent only small minorities of the industry. Of most interest, therefore, are the less vocal members that form the bulk of the industry.

Twenty, ten and even five years ago, the bulk of the fishery industry showed no special desire for a system of official voluntary grade standards. Such standards frequently had been suggested; they had often been investigated, discussed, and argued, and occasionally even recommended. In 1939 and again in 1950, bills to provide for Federal inspection and grading of fishery products were introduced in Congress. However, these bills died because they were favored by so few in the industry. During those years a fear of standards seemed to be the dominant attitude. The majority of the fishery industry apparently had no desire for standards, whether they were mandatory or voluntary.

During 1953 and 1954 there were several signs that the industry's attitude towards standards was changing. The producers of at least five products took definite actions to develop quality standards. (1) Several of the major *breaded shrimp* producers, under the leadership of a National Fisheries Institute committee, agreed to tentative standards for maximum amounts of breading. (2) A large share of the Gulf of Mexico *shrimp* producers, through a committee of the Shrimp Association of the Americas, completed the preparation of codes for handling and processing fresh shrimp. (3) Packers of *crabmeat* from the Atlantic and Gulf Coasts, with considerable help from the National Fisheries Institute, cooperated in preparing a voluntary code aimed to improve the sanitary quality of crabmeat. (4) The *Maine Sardine* Industry, with cooperation from the Fish and Wildlife Service, developed practical procedures for inspecting and grading canned sardines. (5) The *fish stick* producers, through National Fisheries Institute committees, started to develop standards to improve and maintain the quality of their product. These efforts to develop standards were all initiated and promoted by industry groups. Therefore, they appeared to be excellent indications that the industry was no longer averse to standards.

As indicated by papers given at the Gulf and Caribbean Fisheries Institute 1954 meeting, both government and industry leaders took cognizance of the

apparent shift in attitude towards standards. Both groups were anxious to know whether the shift was real or superficial. The National Fisheries Institute wanted to gauge the new attitude so that it could effectively promote the industry's desires and best interests. Similarly, the Fish and Wildlife Service officials wanted to determine the extent of the industry's interest so that they could plan effective and valuable projects on developing grade standards. They did not wish to expend funds and time if standards were not really wanted by the majority of the industry. Would this desire for standards last or would it fade away within a few months? Would the industry as a whole accept or reject voluntary standards? And most important as far as the government was concerned: was the industry ready to shift its interest from industry-applied standards to official government standards? To secure answers to these questions, the National Fisheries Institute Technology Division was commissioned to make a thorough survey of the industry.

Two technologists visited nearly all important production and distribution areas in the country. Personal visits were made to more than 300 firms, located in over 100 cities, in 27 states. Standards were discussed with representatives of every factor interested in fishery products: fishermen, processors, wholesalers, brokers, distributors, exporters, retailers and consumers. Numerous additional contacts were made in group meetings and at conventions. The firms and individuals contacted, represented a fairly good cross-section of the nation's fishery industry. Therefore, the conclusions drawn should be valid.

Only a few individuals in the industry have had prior experience with official voluntary grade standards for foods as applied by the Agricultural Marketing Service. Many confused the suggested voluntary grade standards with the mandatory minimum standards and definitions of the Food and Drug Administration. Before attitudes could be determined it was often necessary to explain in detail the exact nature and operation of voluntary grade standards.

An attempt was made to classify the general reactions of the people visited. This showed that approximately 25 per cent were confident that a grading system would help the industry and they wanted standards for fishery products in general or at least for their own products. About 35 per cent believed that grade standards might be of value and therefore they should be tried at least on a few products. Another 25 per cent had no objections to voluntary standards, but really doubted standards would be practical. Eight per cent of those contacted either considered standards useless or possibly dangerous. The balance showed no interest in a grading system or were completely non-committal. Thus it seems to be fairly safe to say that approximately 80 per cent of the industry appears to favor giving an official voluntary grade standard program a modest trial.

As might be expected, those that favored giving standards a trial had a variety of ideas. A few even asked for mandatory, federally enforced, very strict standards. A large majority agreed that a few standards should be developed and made official as soon as possible. After these few standards have been given a fair trial, the industry should then decide what further action to take. If the first two or three standards prove practical and valuable, a wider appreciation of standards for other fishery products might be sought by the industry.

An attempt was made to determine which sectors of the industry had the most interest in standards, and which would be most cooperative in developing standards. It was generally agreed by producers and handlers that the program would be most effective if the following products should be given prior attention:

(1) fish sticks, (2) breaded shrimp, (3) blue crabmeat, (4) fresh fish, (5) fish fillets, and (6) fresh shrimp.

During 1955 the industry took several steps that confirmed the change in industry's attitude. The fish stick industry took the longest strides towards official grade standards. By the first of the year the N. F. I. Fish Stick Committee, working with technologists in the Fish and Wildlife Service Boston Laboratory, had already developed a polished draft of suggested standards for grading fish sticks. The details of the suggested standards and the possible procedures for applying them were thoroughly discussed at a meeting on February 2, 1955, to which the fish stick industry was invited. Only a few minor changes were suggested. Then the group unanimously adopted a formal resolution requesting the Fish and Wildlife Service "to (1) issue official voluntary standards based on 'Proposed Standards for Grades of Frozen Fried Fish Sticks' developed by the N. F. I. Industry Committee and (2) make available a grading and inspection service for voluntary use by the industry." The following April the Fish Stick Committee reaffirmed its February 2nd request to the Fish and Wildlife Service and also requested official grade standards for fish blocks.

At the 1955 N. F. I. Convention, the Breaded Shrimp Committee discussed quality problems and agreed to consider adopting standards. The Committee decided that all shrimp breaders should be called to special meetings to consider the whole question of the need for quality improvement and of voluntary standards. In June at Miami Beach and in July at Houston and Los Angeles, representatives of the industry met and agreed that more than breading percentages were involved in quality, and showed interest in standards on the raw materials they use. They were not yet sure that it would be practical to apply grade standards to breaded shrimp, yet they agreed unanimously to ask the N. F. I. Technology staff to work with Fish and Wildlife Service technologists to prepare a suggested draft of standards. That draft was prepared and has been submitted for review by several breaders.

The fresh shrimp industry is still basing its plans for quality improvement on industry-applied standards. The Shrimp Association of the Americas has developed excellent production and handling codes. Now it is struggling to establish an effective procedure for enforcement. The quality problem is being attacked from another direction by two local shrimp producers' associations, at Tampa and Fort Myers in Florida. The producers there have adopted a fairly simple quality grading system and employ their own inspectors.

Visits with crabmeat producers from Maryland to Louisiana indicated that a majority recognized that quality improvements were desirable. Although there was no strong desire for grade standards based on the flavor, odor, appearance, freedom from shell, etc., nearly all agreed that there should be some standard product designations. A meeting was held to which all producers of blue crabmeat—from the Gulf and Atlantic Coasts—were invited. Several of the major producers attended. The group resolved to ask health agencies to agree on uniform bacteriological tests and limitations. Also the producers agreed that action should be taken to reduce the confusion of names. A committee was commissioned to work on the problem.

Three sessions of the N. F. I. Convention in April were devoted to fresh fish industry problems. Nearly all wholesalers of fresh fish believed that an overall improvement in quality would cause a substantial increase in demand. Unfortunately few felt that a company can benefit itself by quality improvement.

Most of the firms insisted, and probably rightly, that they must temper their quality efforts to meet the price structure set by less careful competitors. It was agreed that standards for grading fish would be desirable, but probably not possible for quite a while. Instead, the Fresh Fish Committee asked for a self improvement program, based on a code of proper practices. The members believed this could be a preparatory step for the adoption of grade standards. The Committee proposed that a fresh fish quality improvement project be financed by the Fish and Wildlife Service with "Saltonstall-Kennedy Act" funds. Recently, the Service announced that an allotment for such a project had been approved; work should start soon.

In summary it can be concluded that the bulk of the industry does not fear the thought of standards, even official standards, if they are voluntary. The industry recognizes the drastic need for improvements in quality and in marketing practices, and is willing to give an official voluntary grading system a cautious trial.

Voluntary Standards For Fishery Products — an Industry - Government Cooperative Job

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AT THE SEVENTH ANNUAL MEETING of the Gulf and Caribbean Fisheries Institute, the general theory of standards was discussed. A hypothetical case was described showing how a voluntary federal standard of grade and condition would be applied to fishery products. The new and popular fish sticks were used as an example.

Further steps have been taken to advance voluntary federal standards, and success now depends on the practical use of standards. A draft of a voluntary standard for frozen fried fish sticks has been developed, the industry working closely with the Service on this. A preliminary draft of a breaded shrimp standard is being developed for industry comment. Thus, Government and industry have experienced together the somewhat complex but very educational processes any group encounters in the launching of the standards "ship" into relatively unchartered seas.

It may be thought that the field of voluntary federal standards has already been thoroughly explored—for example, by those in the poultry or processed fruits and vegetable field—and their principles applied to the fishing industry. Since fish are more perishable, greater safeguards for quality and therefore stricter standards are necessary. In order to retain their quality, fish are handled differently, stored differently, and marketed differently than poultry or vegetables. Our new work in the development of standards supplies ample proof of that statement.

A brief review of our experiences in this new area of industry-Govern-

ment effort may illustrate that even though the fishing industry is one of America's oldest, it is at the same time never too old to adopt new ideas.

Our first joint experience in the development of voluntary standards for fishery products began in April, 1954. This occasion was the effective date for a cooperative study financed by the Maine Sardine industry to find ways and means for quality improvement in canned Maine sardines. Within a twelve month period it became possible by working in cooperation with the sardine industry quality control committee and interested plant operators to develop guide lines and evaluation factors acceptable as the basis for a state inspection and certification system. In 1955, the State of Maine, by passage of appropriate legislation, has implemented the program on a voluntary or educational basis to demonstrate that improvement in quality will be profitable to the industry. The sardine industry in Maine has set up a quality control laboratory and spares no effort to see that the consumer finds uniformity in quality for grade of product purchased. The valuable lessons from this first venture into the voluntary standards field have been applied in our subsequent work.

It may be that other competing protein products are experiencing the same kind of "growing pains," as for example innovations such as ham sticks, turkey sticks, or breaded pork chops, which are available on the retail market. Fortunately, the fish industry has already certain advantages over these products. The industry knows how to freeze, package and store the basic fishery products, and the so-called specialty products such as the popular pre-cooked breaded fishery items. What the fish industry now lacks is the valuable tool for maintaining a continuous market, that is, standards, which many of these competing products already enjoy by virtue of their membership in the large family of agriculture products.

In 1955, the Government tried to focus the industry's attention first to the assistance that standards can be to every segment of the fishing industry, and secondly on the importance of the active participation of interested persons to make the standard, when drafted for public comment, a realistic and practical measure of the product for marketing. The paramount importance of industry participation and comment in the detailed review of the first working draft, and then the provisional draft of such a voluntary standard cannot be over-emphasized. Government research agencies cannot complete a helpful standard without the full and continued support of the fishing industry in these respects. In fact, it would be impossible to launch into a standard program without the active interest and substantial approval of that part of the industry concerned with the particular product.

The standards have to be practical from the economic standpoint if they are to be usable. Compliance with standards generally requires some plant alterations, which cost money. Standards are of no advantage unless they pay back a real dividend in greater sales volume, a better price or a more satisfied customer. A fair and neutral opinion on the quality, for example, of a lot of breaded shrimp offered for sale to a chain store buyer by a broker can result in buyer's resistance if quality alleged is not borne out by the grading to the standards specifications. The effect does not stop there. The broker can then request a grade certificate for the next lot of this product he orders from the packer. The control then is transmitted from the distribution chain back to the packer. The packer profits by the reaction thus set in motion by insisting on known quality in the raw materials he purchases from the fishermen, the

breader, the cooking oil manufacturer, and the supplier of packing materials. This is the reason for early review of a proposed standard by all of these people at the operating level.

Government and industry are anxious to further the acceptability and hence the volume of trade in fish and fishery products. For years it was debated as to what was the best way to accomplish this obviously desirable goal. A number of courses of action have been tried, including mass advertising, tie-in sales, group demonstrations, national and local fish weeks, and other recognized merchandising techniques. The per capita consumption figure of approximately 11 pounds of fish and shellfish per year in the United States could well be increased. Perhaps adequate attention has not been given to an additional tool that the industry's competitors in the agriculture field have been using for about thirty years, namely, an impartial evaluation of rank and uniformity of quality in the product offered in the market place.

The Service has stepped into this field of development of voluntary standards at industry request. It is giving this work its best effort in relation to the personnel and facilities available. The maximum effectiveness of these efforts can only be achieved through industry's interest and vigorous support. This way all concerned can reap the maximum return for the dollars and the thought thus far expended in the first year of this undertaking. The second year's progress will be largely a matter of industry's participation.

The Service acknowledges with thanks the capable assistance of those who helped to bring the draft of the fish stick standards to its current stage and in development of background material needed for preliminary stages of the breaded shrimp standard. This program can be extended to other fishery products as industry interest warrants, and it is the Government's sincere hope that every step will be a long one forward.

Sanitary Standards For Crab Plants

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EACH YEAR the popularity of crab meat as a seafood delicacy increases. With this increase in popularity comes an increase in production. Today the production of fresh crab meat has become a year-round industry in Florida. Unfortunately, crab meat has been implicated in food-borne outbreaks. It has been recognized by health authorities that the regulations used in sanitary control of the industry are out-dated and do not offer the public adequate protection against potentially dangerous foods.

Crab meat is an excellent example of a food stuff over which a constant supervision must be maintained. The meat of the blue crab that is sold as fresh crab meat consists primarily of muscle tissue. The crabs are cooked live and the meat is picked from the bodies and claws. The picked meat constitutes the muscle tissue and is primarily protein. However, once this protein has been heat treated it breaks down sufficiently to make it a good bacterial growth medium. Cooking breaks the glycogen in the muscle tissue down into simple

sugars which enhance the bacterial growth medium already present.

Due to the picking of all crab meat by hand, each particle of crab meat is afforded an excellent opportunity to become infected with a variety of bacteria. This is the problem faced by the officials who are becoming more aware of the hazards as they observe the occasional food-borne disease caused by crab meat.

The first examination of production methods by public health officials revealed deplorable conditions under which crab meat was produced. It appeared that all of the processing was far from sanitary. Cooked crabs were usually cooled in areas unprotected from flies and rodents. Cooking usually consisted of boiling the crabs, or sometimes cooking them with the addition of steam in wooden boxes with cracks stuffed with burlap. Frequently, cooked crabs were dumped on poorly constructed floors to cool. After the bobbing operation, the backed crabs were dumped onto picking tables that were generally made of bare wood with many filth-filled cracks.

The pickers wore the worst worn and most soiled clothing they possessed. The pans into which they picked the meat were usually badly battered, and if made of enamel were frequently chipped. The picking knives had wooden handles which were frequently wrapped with rags. The crevices between the handles and metal blade portions were often filled with filth. Picking rooms were built without regard to sanitation. The interiors of the rooms were filled with dust catching rough surfaces and ledges and were poorly lighted and ventilated. Nearly always the floors were of wood and in the picking rooms, they were generally littered with crab scraps. The picking tables and handwashing, utensil cleaning and washing facilities were all crudely made and almost always found to be inadequate.

No proper arrangement for cleaning and sanitizing of utensils and other equipment was provided. Most of the meat contacted the hands of the pickers and packers. Generally these employees were women with little or no training in sanitation.

In 1946 the Florida State Board of Health issued new specific sanitation standards in the form of regulations for the control of the handling, packing and the marketing of crab meat. These regulations were more rigid and much further reaching than earlier regulations which dealt with food stuffs in general. These regulations resulted in considerable improvement in the construction and operation of the crab meat packing houses.

The regulations covered both the equipment and the operational procedures within the plant. These were comparable with the standard requirements for good food handling practices. The building now had to offer protection against the elements, insects and rodents. The equipment within the building was to be made of metal suitable for the operation and so designed as to be easily cleaned and sanitized.

Some compromises in the regulations were made so that existing oyster houses could be used for the handling of both oysters and crab meats. This was due to the fact that one area of the state had a marketable production of both oysters and crab meat at different seasons. In all cases basic requirements were to be met such as the supply of potable hot and cold water to all parts of the plant, adequate cleaning, toilet and waste disposal facilities.

Over a ten year period, by observing the employees handling the crab meat, questioning the operators about their operational procedures, some new

concepts evolved. It was found advantageous to minimize the manual and mechanical contact with the product. As an example, originally the pickers put the meat on trays, carried these to a weigher for inspection, then they packed the meat into cans and weighed it. This procedure required the handling of the meat by two people and two pieces of equipment. To minimize the number of contact points the pickers were required to pick the meat directly into the cans, then take the cans directly to the weigher, thus eliminating the picking pans. Next the pickers were required to pick the crab meat directly into the cans and weigh the meat themselves. Seemingly this advance in handling methods turned into a long, tedious educational process.

The 1946 rules and regulations have helped much towards general improvement in construction, plant operation and sanitation. All plants in Florida were carefully surveyed, each operator was given copies of the survey reports and of rules and regulations known as the State Sanitary Code, Chapter XV. The improvements in the plants needed to meet the Sanitary Code requirements were pointed out to the operators as the requirements for certification. This certification was the legal manner of obtaining compliance with the regulations since no plant could operate without this certification.

The response to this procedure was gratifying. Not only did the plants take an interest in their own certification, but they showed interest in their competitors' operation. Periodically, lists of the certified plants were published by the State Board of Health and distributed to all areas within the state and to other interested agencies. As each plant complied with the regulations its name was added to the list of certified producers of crab meat in Florida.

Informal bacteriological surveys of samples of crab meat taken from both the picking tables in the plants and from crab meat in shipment have shown a vast improvement in practically all segments of the industry. Using the Most Probable Number of Coliform organisms as the indicator for the quality of the meat, it has been found that 64 per cent of the first samples of the meat taken from the plants showed the presence of coliform organisms. As each succeeding batch of samples was analyzed this percentage dropped and it is hoped that the future samplings will show meat which may not be bacteriologically sterile but will be completely free of enteric organisms or other possible pathogens.

Another change in the handling of crab meat which would provide added safeguards to consumers involves the packaging method. Fresh crab meat is currently marketed in cans which have perforated bottoms so that the meat may drain, and which have snap-on lids. This type of packaging of fresh crab meat offers little protection during the handling and shipping. It is felt by those working with the industry that in future crab meat should be packed in hermetically sealed cans and be heat treated at temperatures lethal to all pathogenic organisms. This procedure is standard with almost all other canned food processors. It is the feeling of other workers that the crab meat industry must also modernize its thinking and provide quality through the use of the most up to date plant facilities, packaging methods and laboratory quality controls.

Voluntary Federal Standards for Frozen Fried Fish Sticks

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HISTORY:—At the April 1954 Convention of the National Fisheries Institute the first formal action was taken towards stabilization of the quality of fish sticks through the appointment of a fish stick committee representative of the industry as a whole. A technical sub-committee was selected and instructed to study the problem and to make specific recommendations regarding development of standards for grades. At a meeting in Boston in the latter part of 1954, the sub-committee recommended that voluntary grade standards similar to those developed and applied for agricultural products should be developed for frozen fried fish sticks. The Fish and Wildlife Service was asked to carry out this work in cooperation with the industry. The Service phase of the project was assigned to the Boston Technological Laboratory.

Laboratory research work was already in progress on determining and evaluating those characteristics of fish sticks that would be useful in defining the overall quality. Commercial products were compared with those prepared on a laboratory scale. Storage studies were carried out to establish those properties essential to the quality of the product.

By the first of the year 1955, the Boston laboratory working with the N.F.I. Fish Stick sub-committee had made considerable progress in the development of the descriptive standards for grades. A preliminary draft was submitted to industry for comment. The entire fish stick industry was invited by N.F.I. to meet in Washington, D.C., on February 2, 1955, to discuss the fish stick standards. Some changes were suggested. The group also voted to adopt a formal resolution requesting the Fish and Wildlife Service to (1) issue official voluntary Federal standards for grades of frozen fried fish sticks and (2) make available a grading and inspection service for voluntary use by the industry. At the N.F.I. convention held in New Orleans last April, the Fish Stick Committee reaffirmed this formal resolution to the Fish and Wildlife Service. Prior to the convention a revised draft of the standards was submitted to the industry for comment. Further discussions were held at the convention and a few comments were received. On August 10, 1955 at a meeting held in Boston of the subcommittee the final suggested changes were discussed. Following that meeting the Boston laboratory prepared a revised draft dated September 8, 1955. This draft has been distributed for comment to members of the industry representing all phases of the fish stick industry, including producers, brokers, distributors, and consumer organizations. These comments are now being considered.

Basic Principles in Development of Standards

The real problems are those involved in preparing the descriptive requirements and test procedures. According to the United States Department of Agriculture as reported by F. L. Southerland in the February 1954 issue of *Quick Frozen Foods* there are 6 basic principles which must be employed in the development of practical and useful standards. These are:

1. Standards must be based on the actual styles, types, and quality gradations of the product being produced and marketed, and not on theoretical possibilities.

2. Standards must be national in scope.
3. Standards must take into consideration the important factors that affect the relative desirability of the product.
4. Standards must provide for options or personal choices with respect to style, type or variety, product unit size or number of units per container, seasoning, and size of container.
5. Standards require the proper selection of factors upon which quality is to be based so that these factors can be appropriately and consistently evaluated.
6. Standards should incorporate, where possible, objective tests and procedures for use in determining compliance with the requirements of the standards.

Other important problems include (1) establishing a suitable definition for the product, (2) designating product unit size, and (3) establishing grading nomenclature.

With these principles in mind the Boston laboratory and the N.F.I. Fish Stick Sub-committee tackled the job of developing the practical descriptive requirements and test procedures for the voluntary Federal standards of grades. To be of greater value to the industry, these should be such that they could be used and applied by qualified members of industry.

Observations of plant processes, discussions with plant operators, distributors, and consumers, and research on quality and storage characteristics of frozen fried fish sticks revealed important data useful in developing the basic requirements for the standards. It was found that:

(1) The quality of frozen fried fish sticks is directly dependent upon the original quality of the fresh fish, the subsequent care exercised in their handling, and in preparation and storage of the frozen blocks, the proper condition and care of breading materials, and the workmanship in the preparation of the frozen fried product.

(2) Commercial fish sticks, carefully prepared from non-fatty fish and with good quality materials, were found to be of good acceptability after 8 months' storage at 0° F. Those prepared from oily fish have a storage life of less than 6 months.

(3) When stale fish or fish of poor quality are used in the manufacture of frozen fish sticks, the processing involved does not wholly drive off or mask undesirable spoilage or other off-odors that were present in the original raw material.

(4) Continued use of "spent" frying fat causes an unpleasant off-color in the fried sticks and soggy texture in the breading, and decreases the storage life of the product.

(5) Breading materials which contain too high a moisture content produce sticks that are more susceptible to rancidity.

(6) The important factors determining the degree of acceptability of long-stored, carefully-handled fish sticks appear to be the progressive loss of delicate fish flavor and adverse changes in texture.

Besides this useful information, the various characteristics which reflected the quality of the product were evaluated, classified, and defined.

It is not a particularly easy or simple problem to set up ratings for a processed product that will stand up under challenge. Many workers find it relatively easy to evaluate to their own satisfaction a particular sample of

fish sticks. They have their own personal preferences and descriptive terms of quality. Some packers have set up terms and guide lines that are convenient and useful within their organizations. However, communication with other people and other organizations requires a common language and a recognized standard set of quality values.

Definition of Product

Before a set of standards can be devised, therefore, the first step is to define the particular product. Lacking an official standard of identity to incorporate by reference, cooperative efforts on the part of the Service and the industry fish stick committee resulted in the following definition:

Frozen fried fish sticks are uniform, rectangularly shaped portions of breaded, pre-cooked, and frozen fish flesh: Rectangular portions of fish flesh are coated with a batter and/or breading; are cooked by frying in cooking oil or fat; are frozen and maintained at temperatures necessary for the preservation of the product. Frozen fish sticks are composed of at least 60 percent fish flesh. The largest dimension of each stick is at least 3½ times that of the next largest dimension (width). The sticks shall have an average weight of not less than ⅔ of an ounce and not more than 1½ ounces with due allowances for normal processing variations.

Originally Proposed Grades

In developing the basic requirements, one of the principles that concerned us most was that "standards must be based on actual quality gradations of the products being produced." It was found on examining a number of commercial products that a certain few packers produced a consistently high score product. It was believed, also, that the consumer now expects a premium line of frozen foods which he will buy because of quality not just because of price. With these premises in mind, then, the original proposed standards included four grades: AA for high quality premium products, score of 90-100 points; Grade A for high quality products, score of 80-89 points; Grade B for products of medium quality, score of 70-79 points; and Substandard for products not meeting the next higher grade, score of less than 70 points.

At the 1955 N.F.I. Convention the Fish Stick Committee studied the matter and recommended reclassification of the grade levels from 4 to 3 and a broadening of the score ranges within each grade classification.

It was felt that the standards as originally developed provided for too narrow a classification of the top quality grade and did not necessarily provide for normal processing variations. There also seemed to be some objection to the general use of the "super" grades such as the AA and a trend toward the use of common symbols A, B, etc.

Presently Proposed Grades

A reevaluation was made of the descriptive requirements and scoring system. The present standards call for three grades: A, 85 to 100 score; B, 70 to 84 score; and Substandard, less than 70 score.

The three general factors which are considered in scoring the product are "Appearance," "Character," and "Freedom from Defects." The total point score allotted for each factor was based on the relative importance of that factor in contributing to the overall quality of the product.

Under "Appearance" various sub-items are involved which primarily reflect workmanship. These are (1) arrangement of the sticks in the package; (2)

condition of the package—that is conditions reflecting workmanship of the product; (3) uniformity of sticks; (4) color; and (5) adherence and continuity of the coating.

"Character" refers to (1) the ease of separation of the individual sticks; (2) oiliness of the product; (3) texture of the coating and (4) texture of the fish.

Defects are classified as (1) blemishes which include blood spots, bruises, pieces of skin, dark carbon specks and protein curd spots; (2) broken sticks; (3) damaged sticks; and (4) bones.

The scoring was set up with each sub-factor contributing a weighted amount to each factor score. The cumulative rating for each sub-factor then provides the total factor score.

Flavor and odor of the cooked fish sticks are evaluated but not scored. Objective methods of measurements are not as yet available which will indicate reliable gradations in score values. Grade A sticks must possess a good flavor and odor; Grade B, reasonably good flavor and odor. It is entirely feasible that a high score product reflecting excellent workmanship may be graded substandard because of poor flavor and odor. A product with good flavor and odor but with poor appearance or character, or showing a substantial amount of defects could not be given a high grade.

Summary

In summary, the net result of the efforts of the Service and the N.F.I. Fish Stick Technical Subcommittee has been the development of a proposed set of voluntary Federal standards for grades for frozen fried fish sticks. This draft dated September 8, 1955, has been distributed to all phases of the fish stick industry for review and comment.

Development And Promulgation Of Voluntary Federal Standards And Inspection Of Frozen Breaded Shrimp

ARTHUR NOLTE

Fishery Products Technologist
Fish and Wildlife Service
College Park, Md.

IN A COUNTRY RICHLY BLESSED with an abundance of foods, competition for the consumer's favor is keen. Two companies recently placed new frozen foods on the market. They are breaded chicken and turkey sticks. These products add to the wide variety of foods from which the homemaker can choose in competition with frozen sea foods, such as breaded shrimp. The homemaker of today is discriminating in her purchase of foods. She is attracted by the convenience of preparation, the quality, and the value of the foods offered by the manufacturer. Breaded meat, poultry and fishery products competition furnish plenty of incentive to bring the quality of breaded shrimp to its highest level.

Voluntary federal standards of quality and condition of breaded shrimp is a

method of assuring the purchaser that the product is good. It is an important tool to help the industry win the favor of the buyer.

What is the quality and dependability of breaded shrimp in general? The findings of the National Fisheries Institute of the past few years will provide an answer. The Institute examined many brands of breaded shrimp. Some were of good quality, but half were found to have serious faults.

In the course of this program to develop standards for breaded shrimp, packages of all of the brands of breaded shrimp on the market in the Washington, D. C. area were examined. Some attractive, high quality packages were found, but others had considerable faults. The principal factors believed to be significant in the modification of quality were evaluated. These factors were incorporated into a preliminary draft of voluntary federal standards for the breaded shrimp and copies of it have been circulated to members of the industry by the Fish and Wildlife Service. The purpose is to obtain helpful ideas from the producers. Constructive comment and criticism of the preliminary draft will be welcomed by the Service. They will be carefully considered as possible leads to desirable improvements.

The preliminary draft of the standards for breaded shrimp consists of a product description, styles, sizes, grades and factors of quality. The factors are "appearance," "characteristics" and "freedom from defects." The product description requires that the shrimp be good, clean and sound. They should be coated with batter and/or breading and stored in accordance with good commercial practices.

The styles are "light breading," "medium breading," and "heavy breading." "Light breading" means that the breading content is less than 25 per cent by weight of the product. "Medium breading" means that the breading content is 25 to 40 per cent by weight. "Heavy breading" means 40 to 52 per cent by weight of breading.*

The figure 25 per cent of breading suggested for "light breading" is based on the breading content of comparable breaded meat products. According to Mr. R. M. Mehurin, of the Meat Inspection Branch of the Department of Agriculture, breaded meat products are permitted to have not more than 25 per cent of breading. This is a mandatory requirement.

The National Fisheries Institute reported that the average content of breading of the packages of breaded shrimp examined by them in 1955, was 51 per cent. Our investigation of brands purchased in the Washington, D. C. area recently, showed a range of 40 to 54 per cent of breading.

Size and uniformity of the shrimp are important. A large grocery chain specifies 26 to 35 count shrimp for their purchases. Some of the homemakers, according to a survey made by the Service, expressed the desire that the size should be printed on the package.

The shrimp in some of the packages examined were non-uniform in size and shape. The shrimp count range was 35 to 65 per pound, after the breading had been removed.

The sizes of the breaded shrimp might be shown on the package according to the terms Jumbo, Large, Medium and Small. Jumbo shrimp are 15 or less per pound; Large, 15 to 20; Medium, 20 to 30; and Small, 30 to 60 per pound, according to the preliminary draft.

Flavor and odor are the most important quality factors. They are evaluated, but not numerically scored. The grade cannot be higher than that determined

by the two factors, regardless of the rating received from the scored factors alone. Regardless how excellent the breaded shrimp is otherwise, the consumer demands that it tastes good.

The factors "appearance," "characteristics" and "freedom from defects," are scored numerically, on a scale of 100. The maximum number of points given for appearance is 35, for characteristics 25 and for freedom from defects 40.

"Appearance" relates to uniformity of size and shape, amount of loose breading, presence or absence of "dough balls," properly adhering coating, presence or absence of excess moisture, heat damage or dehydration.

"Characteristics" refers to ease of separation of individual pieces, presence or absence of broken pieces and separated breading, and to the texture of the flesh.

"Freedom from defects" refers to the degree of freedom from heads, "veins," walking legs, antenna, damaged shrimp, and blemishes such as black spots.

The proposed grades of the breaded shrimp are based on the statements mentioned. They would be U. S. Grade A or U. S. Fancy, which scores 85 points, U. S. Grade B or U. S. Extra Standard, not less than 70 points. Grade C scores less than 70 points.

One packer explained that he could pack a higher quality product, but that would raise his costs, and then he could not compete with lower priced brands. It is generally axiomatic that premium quality goods command a premium price, when the purchaser has confidence and assurance in the high quality. Grade standards give such assurance. Thus U. S. Choice meats sell at a premium price over U. S. Good or over ungraded meats. Grade AA eggs sell at higher prices than Grade B or than ungraded eggs. If it is assumed the same situation will apply to breaded shrimp, consumers will be prepared to pay higher prices for Grade A quality than for inferior quality.

If a voluntary standard for breaded shrimp is promulgated, a grading service will need to be inaugurated. The grading service will certify the breaded shrimp for class, quality, quantity or condition. The several grading operations will be according to U. S. grades, and contract specifications. Applicants who may request breaded shrimp grade certificates are food processors, bankers, brokers, wholesale distributors, retail grocers, warehousing concerns, railroad agencies and federal, state and city procurement agencies. The certificate may be attached to the invoice or shipping documents to serve as evidence that the product complies with the quality requirements of the sales contract. 1) It may be used by financially interested parties in negotiating sales. 2) It may serve as an aid in arriving at the loan value of the product. 3) It may help the manufacturers to determine if his quality control methods are efficient and satisfactory. 4) It may aid in making equitable settlements of disputes arising over the claims by the owner for damage incurred in transit or in public storage. 5) It may furnish data for the development of buying specifications for interested private, state or federal procurement agencies. 6) It may be used as evidence in law suits or for the settlement of disputes without resorting to court action.

The U. S. Fish and Wildlife Service will continue its interest in the standards field and strive to satisfy and earn the support of all who may find this program useful.

*As the result of public hearings on the subject, the industry has agreed that light breading means breading of less than 35 percent by weight of the product. Medium breading means that the breading content is 35 to 45 percent by weight. Heavy breading means 45 to 50 percent by weight of breading.

Standards for Fishery Products from the Point of View of the Wholesale Buyer

WILLIAM H. WOOD

Seafood Buyer, Hot Shoppes, Inc., Washington, D. C.

IN 1954 the public feeding industry (hotels, restaurants and caterers) sales approximated 16 billion dollars, and the indications are that sales will reach 20 billion dollars by 1960. In the restaurant industry, about 40 per cent of the dollar sales are spent for food, 35 per cent or so for labor, rent and other expenses account for 32 per cent, leaving about 2 per cent as profit. The expenditure of the food dollar is of particular interest. 25 to 30 per cent of the food dollar goes for meat, 7 to 8 per cent for poultry and only 5 or 6 per cent is spent on seafood. In 1954, Hot Shoppes, for example, spent $600,000 for seafood in comparison with $3,000,000 spent on meat. It is recognized that this situation should be changed, and more money should be spent for seafoods. Ways and means of increasing seafood consumption by the catering business were discussed by the writer with the National Restaurants Association, the Director of Research of the National Restaurants Association and others. The opinion of Frank Sherill, president of the S. & W. Cafeterias, was that in order to increase sales, the seafood industry had to bring the quality up to that of foreign products. This was not an isolated opinion. In further surveys among the restaurant trade it was found that everyone agreed that quality must be improved. The only disagreement was as to how this should be accomplished and the cost. There are many ways of figuring costs, and we at Hot Shoppes determine them on a portion basis. However, very often estimates do not include hidden costs which in many instances are caused by poor quality seafood. In 1953, for example, the price of crabmeat was 65c per pound, when it should have been 80c. This was the result of an outbreak of diarrhea in New York City, which, according to the Chief of the Federal Food and Drug Administration, as he told it to the Maryland Chapter of the Institute of Food Technologists, was attributed to unwholesome crabmeat. When the federal inspector approached the producer of this crabmeat his only comment was that "It couldn't have been my crabmeat that caused the trouble, since all of my employees have diarrhea and they don't even eat the stuff!"

Some producers are doing everything possible to maintain quality; still they also have to pay for the tardiness of those who do not comply with the sanitary code. Recently about 50,000 pounds of frozen fillets were condemned in Boston and probably sold as animal feed. Most of you know the difference in the market value of edible fillets and that which has to be sold for animal feed. As a last recourse the fish could be sold to a fertilizer plant at a price which would hardly cover the cost of freight. If the fish producing company is to continue to operate at a profit, one can be sure that the cost or loss of this 50,000 pounds has to be pro-rated over the balance of its sales. This kind of hidden cost can be very expensive by comparison with the cost of adequate processing and sanitation facilities as well as the proper training of personnel.

The Hot Shoppes insist on quality. The company operates in a number of states, and its premises are subject to city, county, state, and, in some cases, federal inspection. This is accepted as a necessary part of the catering business. There exists an element of risk when buying seafood, and the insurance cov-

ering this risk is based upon experience. If one has a claim one year the insurance rate will be higher for the following five years. Needless to say, anything that helps to reduce the risk is most welcome.

Most of Hot Shoppes' experience with seafood has been very good. However, several years ago the company bought a shipment of 38,000 pounds of shrimp and the usual quality control methods were applied. A composite sample was drawn and proved to be satisfactory. All but 10,000 pounds of these shrimp were consumed before any difficulty arose, but the rest of these shrimp the company had to sell through a broker at a loss and purchase replacements at an additional cost of 4c per pound to us. This is another example of those hidden costs which adequate inspection services could eliminate.

Uniformity is an essential requirement and grading for size is an important factor to the industry. It is realized that this presents a problem because the catch does not consist of uniform sized shrimp or fish. When the fisherman drops his net he may get a great range of sizes and the producer has to find a market for all of the fish. It was believed that the grocery stores could serve as outlets for the odd sizes, but actually the large grocery firms, too, are interested in a uniform size, particularly in shrimp. Recently the shrimp producers have done much to improve the size grading and it is hoped that the fish segment of the industry will soon find a way out.

In summary, the public feeding industry offers a great marketing potential for seafood. Increased sales to this market depend, however, on the availability of adequate controls that would safeguard the quality of the product. It is believed that under ideal conditions the feeding industry can absorb as much as $600,000,000 worth of seafood products.

DISCUSSION

Technology Session

Discussion Leader: Francis W. Taylor

Discussion Panel: Harold Alcott, Joseph Stern, John D. Kaylor, Max Meyer

Fishing Industries Attitudes Towards Official Voluntary Quality Standards

Harris Magnusson

Q. Kaylor: Has the Food and Drug Administration expressed any interest in the standards being developed for fishery products?

A. Magnusson: The Food and Drug Administration is interested in developing minimum standards of identity for fishery products. This, of course, is different from the standards which we are trying to promote.

A. Whiteleather: F.D.A. is interested in the fitness of food for human consumption. The voluntary grade standards which we are trying to develop are of a type which F.D.A. is not concerned

with, and go far beyond these minimum standards. Of course, there can be no conflict with F.D.A. mandatory standards.

Q. Stern: Will the army accept the voluntary standards in lieu of "specifications"?

A. Whiteleather: The army and other federal purchasers buy under federal specifications. If there were federal standards they would probably be incorporated into the federal specifications.

Q. Duggan: I would like clarification on how these voluntary standards are developed. In the case of fish stick standards, the first move was by packers, who jointly developed preliminary standards and turned them over to the Fish and Wildlife Service for further work. This is where we are now, and what is the next move?

A. Whiteleather: In the production of voluntary standards the following steps are involved: (1) The development of the standards—the technical research necessary to produce an acceptable practical standard for both the producers and consumer; (2) The promulgation of standards—meaning that they are published in the Federal Register and are thus accorded official status as a U.S. standard; (3) The certification or inspection stage —where inspection is made, on the request of industry, on the basis of the official standards. The fish stick standards are about ready for public hearings and promulgation. There are some legal aspects to be worked out by our lawyers.

Q. Fieger: What per cent of the industry will have to accept the standards before they will work?

A. Magnusson: In the case of other food standards, sometimes the per cent of producers openly using standards is very small, below 10 per cent, and yet the standards are successful because a much larger per cent of the industry is using the standards on a private basis. In meat grading less than 50 per cent of beef is graded, despite the wide acceptance of grading in this product. With butter, again less than 50 per cent is graded. In cases of frozen vegetables and other products you will seldom find grades on the package and yet a grading standard has been used, and the effect has been to raise the quality of the product. Many believe that the main value of standards is not in their effect on the final consumer, who buys by brand or store, but in raising the quality in the industry as a whole.

Duggan (Comment): As a packer it seems to me that a major advantage of standards would be to define clearly the characteristics of various grades, as a guide to the processors. Then "Grade A" has some universal meaning, instead of every packer being able to claim his product was Grade A. The buyer could check the claims of packers against a real standard.

Q. Kaylor: In the National Fisheries Institute tests of fish sticks, how many of the 27 brands met Grade A standards, according to the tentative standards?

A. Magnusson: About half the samples were "Substandard," primarily because of flavor. Three or four of these were "Substandard" because of errors in preparation. Only six or seven were A (or AA, according to the older classification).

Voluntary Standards for Fishery Products— an Industry-Government Cooperative Job

R. T. Whiteleather

Q. Stern: Who will do the inspection in the application of the seafood standards? Will it be the Fish and Wildlife Service, or the Agriculture Marketing Service of the Department of Agriculture?

A. Whiteleather: We want to avoid duplication of function and will make as much use as possible of existing organizations. In the inspection and certification of fishery products we hope to come to some agreement with the Department of Agriculture to use their inspectors, after training them in the inspection of fishery products. If they don't have enough inspectors in a particular location, additional men can perhaps be hired. If this does not work, then Fish and Wildlife Service would have to seek authority to handle the job ourselves.

Q. Stern: If these voluntary seafood standards become a reality, will in-plant inspection be a part of the system, as it is with some fruits and vegetables?

A. Whiteleather: If it is planned to say on a label that all packages of a product are of a certain grade, then continuous plant inspection is necessary. However, if certification of certain lots or codes is contemplated then continuous inspection is not required and the lot can be given a grade by an adequate sampling procedure any place along the distribution chain. This latter is what is now contemplated for our fishery products. The labelling of all packages of a product as, say, "Grade A" is another step ahead, which is not planned for right now.

Magnusson (Comment): Perhaps one thing has not been made clear. It is possible to put on a label many things, provided it is not claimed that the product is government inspected and approved. If the agriculture system is followed, in-plant inspection is necessary if *government* standards of quality are claimed. If, however, industry standards can be used, the grades can be industry definitions of quality. Here, of course, the packer must be certain he is meeting this definition, and be willing to defend this in court. In the early stages of fish stick standard development it was thought that there would not be government inspection, but that industry standards would be used.

Q. Duggan: With voluntary industry standards, a yardstick is provided for a packer's guidance. Then, if I understand correctly, if a packer puts "Grade A" on his package he is not only obliged to prove, if challenged by a buyer, that his product *is* Grade A, according to the voluntary code, but he is also liable to prosecution by the Food and Drug Administration under the charge of mislabelling, if the product is *not* Grade A. Is this correct?

A. Magnusson: Yes, I believe this is correct. Agriculture grading groups do not favor voluntary industry grading because of the chance of laxness on the part of the producers. Producers may not be capable of ensuring packs are actually Grade A, as he claims. This might reflect on other packs, which do live up to the standards.

Q. Kaylor: There is a packer of fish sticks who has on his package, now, the statement that his product is "Grade A". What happens to his standard if government standards are promulgated and his do not come up to the government standards?

A. Whiteleather: It is possible for anyone to claim "Grade A", according to his own standards. There is a great deal of difference between "Grade A" and "U.S. Grade A" and if the former implied the latter, it would be mislabelling.

Magnusson (Comment): I don't know the answer to this problem of packers having their grades before official standards are adopted, but if, after standards are adopted officially, a packer labels his product "Grade A" he is open to prosecution for mislabelling, although it is not as clear a case as it is if he put "U.S. Grade A" and fails to meet the standards. Furthermore, he could be sued for labelling "U.S. Grade A" without permission, so he can be prosecuted two ways.

Q. F. Taylor: Suppose a package is graded as "U.S. Grade A" and later ceases to be "U.S. Grade A". For example a case arose in the west where a trout farm shipped a load of frozen trout to a customer. The latter bought more trout than he needed, and a year and a half later the customer wanted to return part of the shipment. Now the package was Grade A when it was shipped, but of course was not after a year and a half. What can you do when a pack ceases to be Grade A somewhere along the line?

A. Whiteleather: I think this is exactly where standards serve best. In a situation where there is any question of quality, an inspection can be requested. If a transportation company accepts a shipment of Grade A fish sticks and they are found not to be Grade A when they arrive at their destination, then the blame can be placed clearly. This avoids the endless arguments that now take place as to whether the fish were good when they left the producer.

A. Olcott: All grades are dated, and they only say that the lot was Grade A at the time of grading. If a question arises later, then a new inspection must be made and a *new* grade assigned.

Q. F. Taylor: It seems to me that the packer should put the date of production on his package so the housewife could tell how old a product she was getting. This would encourage the merchant to keep the package only for a reasonable time.

A. Duggan: I can answer that with an actual experience. The type of handling a frozen product gets is much more important than the time element. We have dated our packages of fish and recently we had a pack dated October, 1954, almost a year ago. A broker called us from Salt Lake City, very excited, and asked us if we couldn't please leave the date off the package. The customers were complaining about the age of the fish. The quality was good, but the date scared them.

Olcott (Comment): I have sat in on many meetings where frozen food processors have argued about how to keep up the quality during storage. One suggestion has been to devise a frozen food indicator to put on the package to show whether it had been mistreated. At the Western Regional Laboratory, Dr. Anderson devised one, which consisted of a red chemical on a piece of filter paper. With a rise in temperature this red area would spread along the filter paper, and if the food had been mistreated, red would begin to show through a transparent plastic window on the package. This idea has been rejected by the industry, since it would actually not be possible to pin the blame. Some one along the chain does a *little* mishandling of the package, the next fellow does a *little* mishandling and the third does a *little* mishandling, then the red area shows and the fourth man has to pay for the lost product. In some cases a frozen product can be kept for two or three years and still be good, while others, badly handled, will be poor quality in six weeks.

Q. Gilbert: A large proportion of the fish sticks made in the United States are made from imported fish, and Canada is one of the biggest exporters of fish blocks or slabs to the United States. Is there any move to make standards for fish blocks?

A. Piskur: We are working on standards for fish blocks right now and we expect to have the first draft out in about a month.

Q. Gilbert: Is there now any inspection—federal or state—of imported fish blocks?

A. Kaylor: Only the inspection of the Food and Drug Administration. They are concerned, of course, not with whether the blocks are Grade A or B, but whether they are fit for consumption. Food and Drug Administration is strictly regulatory.

Q. Fieger: Have the voluntary standards and grade developed for the Maine sardine industry improved the quality of that product?

A. Piskur The standards as drafted for the sardines are quite workable, according to the state laboratory men, and the members of the industry. Samples of the pack are taken by state inspectors and tested in the laboratory in Orono. The packer is informed of the grades given his product as well as the

grades of competing packers in Maine. The packers are enthusiastic and they believe the system shows up the weak spots, which can be corrected with the help of the state technologists, so that sub-standard grades, which hurt the whole industry, can be brought up in quality. They haven't had time, really, to show improvement in the pack, but they exect to see some by next season.

Sanitary Standards for Crab Plants

GEORGE GEHRES

Q. Olcott: You said the ideal method of preserving crab meat would be in a hermetically sealed can, which would be heated to dispose of the pathogenic organisms. Unless you heat enough so that you actually have a regular canned product, does this not lead to a public health problem? I refer specifically to possible residual spores of *C. botulinus.*

A. Gehres: Crabmeat is the only cooked food product that I know of that is not sealed hermetically in a package, and it seems desirable to use this method with crabmeat. Of course, the added heat treatment would not destroy all pathogens or spores, but would be another protection for the consumer. Some sort of heat treatment like the pasteurization given to milk, might have prevented outbreaks of illness in the past which were due to crabmeat.

Q. Olcott: But that still does not remove the threat of toxins produced by botulinus, which thrives in the absence of air, and in the absence of spoilage organisms, whose production of lactic acid tends to keep botulinus from developing. In California, there has been hesitation about allowing the sale of sealed foods other than foods treated enough to kill all organisms and spores. They finally have permitted the sale of foods in hermetically sealed cans provided the cans are clearly labelled, top and bottom and in large red letters on the side, instructing handlers "Keep Frozen—Do Not Thaw."

A. Gehres: The growth of pathogenic bacteria stops at about 50° F., so if foods are kept below this temperature trouble can be avoided as far as production of toxins are concerned.

Olcott (Comment): Of course, there is no assurance that the housewife or other handlers of the crabmeat will keep them below 50° F.

Strasburger (Comment): I don't believe you will find any record of a case of botulinus caused by ingestion of fishery products. Nearly all cases were derived from vegetable products—products which had been in contact with soil, since botulinus is essentially a soil organism. Even in hermetically sealed containers I doubt that much is to be feared from botulinus from seafood products.

Q. Strasburger: What control has the state over packers to ensure that they cook only live crabs?

A. Gehres: Some dead crabs are probably cooked in nearly every batch. I imagine some unscrupulous operators frequently cook a lot of dead crabs. Not every batch can be inspected, but observations indicate that most operators try to keep the cooking of dead crabs to a minimum.

Q. Strasburger: If the crabmeat is picked directly into the can, how can the amount of shell be controlled? This is a factor of great importance in quality.

A. Gehres: Only spot checks can be made of the amount of shell. In some plants the pack of individual shuckers is identified by numbers so that careless packers can be checked on. In some cases fluorescent light is played over the top of the can, and the shell on top can be picked up. The less the handling of the crabmeat, the less is the bacterial load. The amount of shell is not a health hazard, while bacterial load is. We are trying to reduce the latter, and are not concerned about the shell.

Latest Progress in Establishing Fish Stick Standards

FRANK PISKUR

Q. Strasburger: It seems to me that the standards being developed for fishery products are based entirely on an examination of the product, with no attention being paid to the conditions under which they were manufactured. Do you not feel that some weight should be given to the sanitary conditions and the general character of the plant?

A. Piskur: This goes back to the question of how the inspection is to be made, whether it is to be a spot inspection of the product or a continuous plant inspection, or some other type. It is up to the industry now to decide what type they want. I agree with you that inspection of the plant and of processing methods is a necessary part of completely satisfactory standards. In Maine only product inspection is so far being conducted.

A. Whiteleather: The criteria being suggested now for standards are a beginning. If they are successful we can go on to other steps, and just as fast as the industry wants to go.

Q. Ingle: I was interested to learn that oily fish, when made into fish sticks, have a storage life of about six months. In relation to the questions of mullet, are any oily fish now being successfully made into fish sticks commercially?

A. Kaylor: We can pack ocean perch as fish sticks. These are six to seven percent oil, not nearly as oily as salmon. These perch sticks are acceptable, but experimental mackerel sticks were not. Two things are involved: the amount of oil and the nature of oil, and only actual experience will determine whether mullet can be made into successful fish sticks.

Q. Fieger: Why are flavor and odor not rated on the fish sticks standards? Are these not after all the important criteria as far as the buyer is concerned?

A. Piskur: We rate flavor and odor, but we don't give them the numerical scores. This is because it is difficult to grade these subjective criteria. We have a project underway in our Boston Laboratory to determine the flavor component of fish and when this is finished we may have some way of scoring flavor and odor objectively.

Standards for Breaded Shrimp

ARTHUR NOLTE

Q. Kaylor: What has been the biggest obstacle in developing standards for breaded shrimp?

A. Nolte: So far it has been in getting agreement on the percentage of breading.

Q. Olcott: Are there problems of rancidity with breaded shrimp?

A. Nolte: Not with uncooked shrimp, but there are some with cooked shrimp.

Q. Strasburger: Is any consideration being given in the shrimp standards to the different species of shrimp?

A. Nolte: Not so far. This again is something for the industry to decide whether they want it.

Q. Idyll: Mr. Wood, as a wholesale buyer, do you believe it is desirable to specify the species as part of the grade?

A. Wood: I do not think so. We regard that as similar to some area preferences for brown eggs and another for white eggs. After the shells are removed the eggs are the same. There are certain regional preferences for certain species of shrimp, but I believe that that is due to differences in handling methods or marketing methods, for example, lack of size grading or freshness, rather than to real differences in the taste of the shrimp.

Whiteleather: (Comment) I agree that species of shrimp might in some areas be an important thing to show as part of grade standards, but I believe we are a long way from such refinements yet. This is the first year we have even had statistics on the amounts of various kinds of shrimp caught. What you are talking about, Mr. Strasburger, is an objective to shoot for in the future.

Strasburger: (Comment) You are right, and I am thinking in terms of the future. I believe there will be increased imports of shrimp into the United States, because the demand will not be supplied by our own fishermen. These imported shrimp are of different species from locally produced shrimp, and have different tastes and odors. I believe it is not difficult to differentiate between species, even after breading, and some of these species will undoubtedly be found to be much more desirable than others.

Standards for Fishery Products from the Point of View of the Wholesale Buyer

WILLIAM H. WOOD

Q. Kaylor: Would you be interested in the development of standards designed specifically for the institutional trade, rather than for the individual consumer, which is what we have been concerned with up to now?

A. Wood: I am sure we would. We have had very little trouble with fishery product quality, but we are using a fair amount of imported fish. With standards it is probable that we would use more domestic products. It would be a help to know that what we buy is under supervision in its manufacture and that we would not run into the occasional bad lot.

Q. Hoover: Would you pay a premium for graded fishery products?

A. Wood: We are paying a premium anyway, by buying the best quality. If a graded product was of higher quality than one that was not graded, we would buy it, and pay more for it.

Q. Piskur: Do you develop your own buying specification or do you use federal standards?

A. Wood: Our standards are higher than federal specifications for some seafoods, but are similar for others.

Q. Gehres: What are your criteria in buying crabmeat?

A. Wood: It has to have a "clear," clean taste, and it should be free of shell. Of course, we realize it is impossible to get every bit of shell out, but that is the ideal. If regulations are going to insist that crabmeat be packed directly into containers, I'm afraid the amount of shell will increase.

TUESDAY—NOVEMBER 1

Chairman—GROVER NOETZEL, *Dean, School of Business Administration, University of Miami, Coral Gables, Florida*

The Government's Place In Market Promotion Of Fishery Products

DONALD Y. ASKA

Chief, Educational and Market Development Section
Fish and Wildlife Service
Washington, D.C.

CERTAINLY there is no more important link in the entire commercial fishery industry chain than the final sale of the product to the consumer. Without this final sale there would be no incentive for the other phases of production, processing, and distribution. As in any industry, the success and growth of the domestic fishery industry lie in the vigor with which it develops, maintains, and increases its markets.

However, this is easier said than done. Important as our fisheries may be, they have been faced with increasing competition for the consumer's food dollar, largely as a result of record agricultural productivity and the increased entry into the market of fishery products of foreign origin.

Because of the geographical spread of the industry, the preponderance of small and medium sized producers, and the fact that fish and shellfish as a class are composed of so many different species, it has been difficult for members of the industry to give much attention to other than their own species and areas in their marketing activities. As a result, their activities in promoting fishery products as a class have necessarily been limited. Largely as a result of this condition, the per capita consumption of fish, on a national basis, has not kept pace with the increases for other protein foods.

In recognition of the importance for improving the marketing of fishery products, the Congress on August 11, 1939, authorized the annual transfer from the Department of Agriculture to the Secretary of the Interior of $75,000 "to promote the free flow of domestically produced fishery products by conducting a Fishery Educational Service" and $100,000 to "develop and increase markets for fishery products of domestic origin." These funds were transferred from the Section 32 funds made available to the Department of Agriculture which represent the import duties levied on food products coming into this country. Actually the full amounts of these funds were not transferred until 1946. From that time until the enactment of the Saltonstall-Kennedy Act, our market development program was designed basically to conduct those market development activities, which are beyond the physical and financial scope of the domestic fishery industry. The program was built largely around the development of new markets in the school lunch and institutional fields. During that time, because of the limited staff that could be supported

by these funds, it was necessary to confine our attention to fishery products in general, and we are not able to handle individual marketing problems other than in a very general way. With the addition of the Saltonstall-Kennedy funds, staff and program increases permitted us to vastly expand our market development program to the point where we could give emergency assistance to distressed segments of the fishing industry when the seriousness of the situation justified such action.

As in any other business, periodic unbalances occur for which the commercial fishing industry must necessarily adjust itself. However, marketing unbalances occasionally occur which so affect a major segment of the industry, from fisherman to distributor, that normal industry measures prove inadequate. That is now where we are able to render what we think is valuable assistance. Probably the best example of how an emergency program of this type can be put into action is demonstrated by the recent industry-government cooperative haddock marketing campaign. As cold storage stocks of haddock began to accumulate at an unusually heavy rate during the fall of 1954, a serious marketing condition developed which was reflected in all segments of the Boston haddock industry from fishermen to distributor. As inventories accumulated, the processor found himself with his working capital tied up in cold storage stocks. As a result, it was necessary for him to reduce his purchases of fresh fish over the Boston Fish Exchange. The chain reaction extended to the boat owner and fishermen, who were naturally reluctant to return to the fishing grounds when they knew that the prices they would receive would be so low as to fail to cover expenses. As a result, many of the large ocean type trawlers were tied up in Boston and many of the shore processing plants curtailed operations to the point where unemployment became heavy among the shore plant workers and truckers. This situation constituted not only a problem to the haddock producers, but it raised a threat to producers of other New England fish, who were fearful that the market for all types of New England fillets would break.

At this stage, the Boston haddock industry requested Government assistance in the form of a surplus purchasing program using Saltonstall-Kennedy Funds to remove the surplus stocks so as to stimulate the market and restore normal operations in the area. With the experience of the U. S. Department of Agriculture as a background, it was the opinion of the Departments of Interior and Agriculture, that other means should be developed to overcome the problem. The cooperative industry-government program evolved from these discussions. On January 13, 1955, the Secretary of the Interior announced that the full force of the Fish and Wildlife Service's Market Development Activities would be placed behind the program. At the same time, the industry expanded its sales activities to the degree that its facilities permitted.

The Government's program was built around the following lines: since haddock fillets were an item that fitted price-wise into the school lunch program, circulars were distributed to all of the participating schools in the twenty-three states of the Northeast part of the United States, advising them of the availability of haddock fillets and recommending recipes that would be suitable for their use. These circulars were distributed through the individual State Departments of Education, whose cooperation had been developed largely through the school lunch activities that we have been conducting during the past several years. The larger food trade associations and chain stores were

contacted by the Service, and supported the program very well. These included such organizations as the National Restaurant Association, Independent Groceries Alliance, National Association of Retail Grocers of the U. S., Super Market Institute, the Great Atlantic and Pacific Tea Company, National Food Brokers Association, National Association of Food Chains, National Association of American Railroad Dining Car Officers, Walgreen Drug Stores and about twenty-five other similar food merchandising groups.

The State institutions, such as hospitals, prisons, and rest homes, were contacted by means of publicity bulletins, urging them to use haddock in their menus as much as possible. The Agriculture Department through its Food Trades Branch and Federal Extension Service gave the project special attention through its nation-wide food promotional outlets. Haddock was listed as a plentiful food and the Service prepared press releases containing information on haddock as well as recipes which were distributed to approximately 1200 food editors, dietitians, and nutritionists throughout the country. Personal contacts were made by the Service's field force—which, by the way, was devoted solely to this program for a period of approximately eight weeks—and appearances were made on the radio and TV. Newspaper food editors were contacted to enlist their aid. Service home economists gave several TV demonstrations on the home use of haddock.

The effect of the program can best be evidenced by the cold storage withdrawals of haddock fillets in Boston. At the time the program was started, the holdings amounted to approximately seven million pounds, or about double normal. By the end of January, they had dropped to five and one-half million pounds. By the end of March, they were at four million pounds, approximately one-half million pounds less than on the same date a year previous. This heavy reduction in holdings continued even after the Service relaxed its efforts. As the stocks began to move, activity increased in the Boston area. The processors, now being able to move their stocks, were able to re-enter the fresh fish market. As a result, the boats resumed operations and increased landings began to appear at the Boston Fish Pier. Soon the shore workers were rehired to process the new supplies and a new atmosphere of economic recovery appeared in the area. This recovery can be attributed almost entirely to this industry-government program.

Shortly afterward the Pacific Coast tuna canning industry requested the Service to assist it in a national sales promotion campaign to remove the burdensome stocks of canned tuna which were accumulating at the packers level. In contrast to haddock fillets, whose general market area is confined to the northeastern United States, canned tuna is a nationally distributed item that can probably be found in every grocery store in the United States. As a result, the tuna campaign was conducted on a national basis, and during May and June the sales slogan, "Summertime is Tuna Time," became a familiar phrase throughout the country. Again, the Service found the outlets that had been developed during the haddock program to be equally as effective in the case of canned tuna. The schools, national food trade associations and food trade groups, state institutions, radio and press, TV editors and the Department of Agriculture participated in the program. The industry meantime was using its established commercial publicity outlets to stimulate consumer purchases of canned tuna. Because of the many other factors that have an effect on the marketing of canned tuna, such as the heavy imports from Japan, and heavy

shelf stocks, it is not yet possible to evaluate the effect of this program. However, the industry has indicated that the campaign greatly stimulated canned tuna sales.

Since that time, but in a somewhat less extensive nature, the Service has cooperated with the fishery industry in National Fish Week, the Shrimp 'N Rice Fiesta, and worked in cooperation with the fishery industry during National Tuna Week. Campaigns have also been conducted on a regional basis. For instance, in cooperation with the National Fisheries Institute, a market promotion campaign was conducted at the test city of Columbus, Ohio, to stimulate the sales of fish sticks and fillets. Similarly, in cooperation with the Southern California Fisheries Association, a program was undertaken to stimulate the sales of fish in this heavily populated area, which has an unusually low consumption fishery rate, considering that it is a coastal area. In September, 1955, we cooperated in the Wisconsin Fish Month Program, which was sponsored by the industry in that area.

However, there are other areas in which we are endeavoring to promote markets which are equally important and which have not been as highly publicized. In recognition of the problems confronting the fresh fish industry in Florida, we have entered into a contract with the Marine Laboratory of the University of Miami to increase markets for the fishery products of Florida origin. Progress in this study is reported elsewhere in these proceedings. Another program in which we are engaged is that of developing markets for the under-utilized fresh-water species, such as carp, sheepshead, buffalo fish, and quite frequently, smelts, as an aid to the fresh-water fish industry. Already, promising markets have been explored in the fur-animal food industry and trial shipments are now under way. This represents a tremendous potential market, since the fish have certain qualities which make them highly desirable as fur animal food. In addition, the decline in the horse meat supply has opened up this field for the under utilized fish.

Our programs are not all geared to the emergency level, however, since we are currently engaged in a school lunch demonstration program which this year will include Massachusetts, Maryland, Florida, Kentucky, Indiana, Wisconsin, Texas, South Dakota, California and parts of Washington and Oregon. Cook books, which have proven to be so popular that their sales by the Government Printing Office are exceptionally high, are being developed to cover many of those species which we have not been able to cover up to date. Our fishery exhibit program in such national conventions as National Restaurant Association, American Dietetics Association, American Home Economics Association, National Frozen Food Locker Association, American School Food Service Association, etc., is being conducted to bring to these important food groups the advantages that can be accrued from the use of fishery products. Our motion picture program is being expanded. We will soon have two pictures on shrimp, both industry sponsored and Service produced.

In summation, the Service's market development program is not intended to be a substitute for the industry's market development activities, but is designed to be a supplementing aid to industry activities, with the goal being the maintenance and expansion of the economic levels of our important commercial fisheries.

Problems In Marketing Canned Fishery Products

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Abstract

The biggest marketing problem facing the canned fish industry is the one basic to the entire fishing industry—difficulties in effecting an increase in the per capita consumption of fish in the United States because of the competition of other protein foods. In addition to this basic challenge, fish canners are beset with three additional major marketing problems: fluctuations of raw fish supply, competition from increasing numbers of domestically produced "convenience fish products" in both fresh and frozen forms, and increased competition from imports greatly favored by relatively low production costs.

Florida's Fish Marketing Problems Can Be Solved

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Abstract

The Florida fin fisheries have suffered a market decline during the past few years. After 1953, the market price of mullet, the leading food fish, decreased rapidly.

Research has centered around the following points: (1) the past and present markets for Florida mullet, (2) the forces competitive with the markets for Florida mullet, (3) the possible expansion of present markets, (4) the present methods of handling, preserving, packaging, shipping and selling fish. The major portion of the decrease can be attributed to three factors: first, increased competition from other seafood and meat products; secondly, accelerated growth of the supermarket and conversion of these supermarkets to self-service; and thirdly, the inability of the Florida seafood industry to take advantage of the marketing and technological innovations that occurred during the past few years.

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Production and Distribution Costs in Florida Fisheries

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Introduction

In 1953 the Bureau of Economic and Business Research at the University of Flordia made a field survey to obtain information on the production and distribution activities of the Florida producers (initial wholesalers) of edible fish and shellfish. Part of the information from this survey was incorporated into a statistical report which was presented at a meeting of the Southeastern Fisheries Association in June, 1953.

After the 1953 field survey the Bureau continued its study of the Florida fisheries, utilizing information from a number of sources, and has published a report on its investigations entitled "Florida's Commercial Fisheries—Markets, Operations, Outlook." In the present paper a report will be made on some aspects of production and distribution costs in certain Florida fisheries.

In obtaining production and distribution data in the 1953 survey, questionnaires were sent to all known producers in the state and interviews were carried out with a large sample of them. Although many responded to the questionnaire and interview, adequate and usable production and distribution cost information was received from a comparatively small proportion of these respondents. The average costs reported here are based on only the reports that were usable and thus represent no more than the average costs of those reporting the information. Complete reports on production costs were received on 21 boats engaged in gill net operations, and fishing principally for mullet or Spanish mackerel, on nine boats employing lines, and fishing principally for snappers and grouper, and twenty-two shrimp boats using otter trawls. Although we cannot say that the costs of these operations reflect the averages for these various segments of the industry, it is believed that they are indicative of the cost conditions in the industry because of the similarity of the fishing operations within the segments.

In summarizing and analyzing the distribution costs of the producers, the same approach was followed as that used for production costs. Distribution costs cannot be broken down in the same manner as production operations; however, distributors were classified into three groups on the basis of the principal species of fish handled: those whose most important species were (1) mullet and Spanish mackerel; (2) snapper and grouper; and (3) shrimp. Again the distribution costs of the producers represent no more than the average costs of those reporting.

One of the first problems encountered by the Bureau in its attempt to secure cost data was the lack of complete and accurate firm records on fishing operations—a factor which led to the decision to obtain data on only the producers' major cost elements in production and distribution. A further justification for this approach was the belief that sufficient information would be revealed on the existing cost structure, and about per unit costs of production and distribution, to indicate some of the cost problems in certain major segments of the Florida fisheries.

In examining the information on overall average costs for certain types of fishing operations, various, more detailed aspects of costs were noted that should be subjects for future study. For example, there is a need to examine the influence of geographic location on the cost of mullet fishing. The northern part of Florida's west coast as opposed to the southern part presents different production situations. The type of ocean bottom limits the type of gear that may be used in the northern area and the average sizes of fish are different from those landed in the southern area. There are also the important questions as to the use of other types of gear as a means of increasing productivity over that now being achieved by gill-net fishing. There is need to know more about the efficiency of specific types of boats and gear operations within all of the major fisheries. These matters cannot be dealt with here but study specifically oriented to them should be initiated.

Production Costs in the Mullet and Spanish Mackerel Fisheries

Producers' records reveal that the gross return to small boats may vary from

considerably less than a thousand dollars to over ten thousand dollars per year, depending on the time spent fishing, the skill and success of the fishermen, and the types of boats and gear employed. Given these conditions, which made it difficult to obtain representative data, even if the records were available, it appeared more feasible to examine the cost data on boats reported to be actively engaged in fishing operations throughout the fishing season. The twenty-one boats on which the cost figures for gill-net operations are based ranged in size from 20 to 37 feet. One boat had total annual landings of slightly less than 26,000 pounds, whereas another had landings of approximately 100,000 pounds. Within these limits the majority landed from 40 to 60 thousand pounds during the year. The average number of pounds landed per boat for the year was 53,180. The value of the production per operating unit was $5,763 and the value per fisherman was $2,575. There were an average of 2.24 men per boat, so that on the basis of the average labor cost of $3,166 per boat, the fisherman's average wage was $1,413. The costs as a percentage of the sales value were labor 55.0%, gear 12.0%, gas 19.4%, oil 0.8%, maintenance (repairs) 8.9%, depreciation 7.1%, ice 0.9%. These costs were 104.1% of the sales value of the fish. These figures readily suggest the reason why producers would prefer the fisherman both to own and operate his boat. There is little profit to be obtained from boat operations if costs conditions such as these prevail, and the difference between profitable and nonprofitable boat operations will be closely linked to the costs of maintenance and repairs and the speed with which the replacement of capital items will occur.

Although precise average profit or loss from boat operations cannot be ascertained because of incomplete cost data, the figures on average cost of mullet and Spanish mackerel boat operations show that even though the average wage to the fisherman is low, the average labor cost per pound of fish landed is high. Also, the fuel cost is equal to about 20 per cent of the value of the product landed, which is much greater relative to value of product than was found for the other fisheries. Given this cost situation at the production level, the existing transportation rates, and the customary margins at the various levels of distribution, fresh mullet and Spanish mackerel moving to the New York wholesale market will require an average retail price of from 29 to 36 cents per pound. This is the price for the fish in the round, not drawn or dressed. If mullet and Spanish mackerel are drawn or dressed, the required price will be from 39 to 48 cents. If the two varieties are filleted by the retailer, the required price per pound would be from $1.00 to $1.20. If mullet and Spanish mackerel are sorted, packaged, and frozen before distribution, it is estimated on the basis of an average price of 10.8 cents per pound paid to the fisherman, that the required minimum retail price would be 94 cents. The term "required price" as used here indicates the price which results when the customary margins and transportation costs are added to the average price paid to the fishermen, plus any processing costs that may have been incurred before distribution.

Production Costs of Snapper and Grouper Fishing Operations

The operation of the snapper and grouper boats was characterized by a high degree of seasonality. One boat reported as much as eight months of fishing activity, whereas the remainder reported less time, and several only about two months. The boat operating over the longest period of time reported landings of 180,000 pounds, while the boats operating only two months reported about 20,000 pounds. The value of the production per operating unit was $7,747 and the value per fisherman was $3,874. The costs as a percentage of sales

values were, labor 55.5%, groceries 12.2%, gear 4.8% bait 2.3%, fuel 5.9%, ice 3.2%, maintenance (repairs) 8.2% and depreciation 7.5%. These costs were 99.6% of the sales value of fish. The very manner in which certain costs such as labor, groceries, bait, and fuel were incurred caused them to be high or low per pound of landings depending on the average value of landings per trip rather than on the number of trips. Maintenance and depreciation per pound, on the other hand, will be high or low depending on the total number of pounds landed during the accounting period.

On the basis of the average price of 16.6 cents per pound to the fishermen, the retail price of grouper, in the round, moving into the New York wholesale market, would be approximately 35 cents per pound; if drawn, the required price would be around 47 cents; if in steaks, around 70 cents; and if filleted, around $1.00 per pound. These figures are based on the customary margins and the average weight loss experienced in the various indicated types of processing.

Costs of Production for Shrimp Boat Operations

These boats ranged in length from 49 to 72 feet, with the majority 60 feet or longer. The average gross receipts per boat were $26,900—an average of 48 cents per pound of headless shrimp. The cost as a percentage of sales were, labor and groceries 38.1%, gear 7.7%, fuel 12.2%, ice 7.3%, maintenance (repairs) 13.7%, insurance 3.6% and depreciation 11.2%. These costs were 93.8% of the sales value. Despite the favorable percentages, the per-pound costs of these operations are high in comparison to the costs in the other two types of fishing operations examined. Although shrimp has occupied a very favorable market position, there is need to develop more cost information on the different methods of shrimp fishing. Based on the average costs and margins found for shrimp-boat operations and the corresponding margins for fishhouse operations, headless shrimp moving to the New York wholesale market would require a retail price of approximately 97 cents per pound.

Distribution Costs of Mullet and Spanish Mackerel Producers

The thirteen producers on whose operations the mullet and Spanish mackerel cost data are based handled an average volume per producer of 448,893 pounds of fish, having a net sales value per producer of $70,310. The cost of the principal items as a per cent of sales were as follows: cost of fish sold, 74.2%; wages and salaries 7.9%; wooden boxes and barrels 5.0%; ice 2.0%; telephone and telegraph 1.2%; depreciation 0.9%; heat, light and power 1.5%; taxes 1.9%; insurance 0.6%; office expense 0.2%. These averages reveal the relative importance of the major distribution costs, but perhaps of more importance were the significant variations in the amounts producers were paying for services and materials purchased for operations. In view of the fact that, on the average, these mullet and Spanish mackerel producers were operating on a margin of four cents per pound of fish handled, a slight reduction in a number of these cost items could have a significant effect on the profit position of individual producers.

Distribution Costs of Snapper and Grouper Producer Operations

The four snapper and grouper producers on whose operations the cost data are based handled an average of 1,546,750 pounds of fish per producer, having a net sales value of $449,692. The average costs as a per cent of net sales were as follows: cost of fish sold, 68.5%; wages and salaries 19.2%; wooden boxes

and barrels 2.4%; ice 0.8%; telephone and telegraph 0.5%; depreciation 0.3%; heat, light and power 1.5%; taxes 1.4%; insurance 0.6%; office expense 0.2%.

The gross margin for these producers was 9.17 cents per pound of fish handled. The labor cost of 5.59 cents per pound was by far their largest single item of distribution cost. On a cents-per-pound basis this figure exceeds the gross margin on which the mullet and Spanish mackerel producers operate.

Distribution Costs of Shrimp Producers

The shrimp producers' distribution costs as a per cent of net sales were as follows: cost of shrimp sold, 81.9%; wages and salaries 2.4%; wooden boxes and barrels 1.4%; ice 0.6%; telephone and telegraph 0.4%; depreciation 0.1%; heat, light and power 1.5%; taxes 1.4%; insurance 0.6%; and office expense 0.2%. On a cents-per-pound basis the distribution costs of the shrimp producers were lower than those of the snapper and grouper producers, and yet higher than those of the mullet and Spanish mackerel producers. The wages and salaries, amounting to 1.4 cents per pound, is very little above the comparable figure shown for the mullet and Spanish mackerel producers. This low cost reflects in part the small amount of processing done by the shrimp producers. It was frequently the practice for shrimp to be unloaded from the boat and packed in hundred pound boxes and carried away almost immediately by waiting trucks. This type of operation depended heavily upon a favorable market, and the producer assumed little responsibility for the marketing of the product.

Costs of Services and Supplies

The percentage relationships of the producers' distribution costs give a summary view of the relative importance of the cost components in production and distribution operations. Some idea of the extent to which these influence the total cost picture may be gleaned from these data. A large proportion of the producers reported information on the prices paid for goods and services purchased for production and distribution needs. These cannot be fully examined here, but an analysis of individual items reveals important differences in the prices paid for them. These differences are attributable to many factors, such as the size of the firm's operations, its location, the products handled, and the character of its associated activities. Nevertheless it is important to note that such differences suggest that a number of firms may be able to improve their cost position by securing lower prices than those now being paid for certain commodities and services.

Conclusions

More cost studies are needed to afford the information necessary to appraise some of the specific problems of the industry and the available alternative courses of action that may be pursued. However, the costs examined in the present review indicate a number of problems confronting the three segments of the industry examined. The lack of profit from mullet and Spanish mackerel boat operations suggests why producers are glad for fishermen to be boat owners. Certainly what profit there may be from these operations is closely linked to the costs of maintenance and repairs and to the speed with which capital replacements must be made. The high cost of labor relative to the value of landings does not result in a high wage to the fisherman. This is a clear reflection of the average low productivity per fisherman.

A comparison of like items of cost incurred by the three types of fishing

operations examined reveals wide variations in their relative importance. This is to be expected from the nature of the differences in fishing operations, but at the same time it directs attention to the differences in the cost problems involved. For example, fuel costs are of greater relative importance in mullet and Spanish mackerel fishing.

In production operations such as exist in the Florida fisheries, in which the biggest single item of cost is directly tied to the value of the product, and where wage improvements can occur only as a result of an increased productivity or an increased market value for the product, possible improvements in both production and marketing should be carefully studied.

Wide difference in the prices paid by producers for goods and services used in production and distribution operations indicates that each producer should carefully examine the prices he is paying his suppliers.

Problems in Marketing Menhaden Products

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THE PRINCIPAL PRODUCTS manufactured from menhaden are fish meal, fish scrap, fish oil and fish solubles. Fish meal is clean, dried, ground tissues of undecomposed, whole menhaden fish, with most of the oil removed. Fish scrap is the same material before grinding. Fish oil is the product recovered from the fish press water either by centrifuging or by a settling method. Condensed solubles is the product obtained by concentrating the press water resulting from the hydraulic extraction of oil from fish. It is approximately 50% moisture, with a tendency to thicken when cold, and has a pronounced fish odor.

Problems in marketing menhaden products arise because:

1. Seasonal production hampers year-round distribution.
2. Variable raw materials and processing conditions prevent complete quality control.
3. "Unknown growth factors," protein quality and other values cannot be measured by rapid laboratory methods.
4. Insufficient products make use of characteristics which are unique in menhaden.

One of the big problems in the marketing of menhaden fish meal today is its seasonal supply. During the summer when most of the fishing occurs, the price is usually the lowest, and during the winter when very little material is produced, the price is usually at its peak. Even warehousing cannot always solve this problem, inasmuch as the small manufacturer cannot always finance large stores of material in his warehouse. Many do not have the space available. Consequently, if a buyer wants a year around supply of menhaden fish meal, he usually has to warehouse it himself.

The menhaden industry increasingly recognizes the importance of working out effective quality control, quality standards and methods of evaluating its products. A prime example is fish meal which interests the feed industry because:

1. It is a good source of the "unknown growth factors" which are believed

to be necessary for optimum growth and performance in animals.

2. It supplies a high quality protein, when properly processed, that contains a liberal quantity of amino acids.
3. It is a good source of the B-complex vitamins.
4. It also adds liberal quantities of calcium, phosphorus and trace minerals.

In spite of these known values in fish meal, there is often considerable concern over the variations occurring in the product. The buyer is beginning to insist upon closer tolerances in moisture, protein and fat content. Limits on moisture can be controlled by careful drying procedures. Properly operated dryers help assure high protein quality while careful supervision of pressing is at least a partial answer to excessive fat contents. On the other hand, there is an impressive list of variables which presently constitute a serious problem in attempting to produce uniformly high quality fish meal and other menhaden products. This can be illustrated by the following examples:

1. Effect of species: Here the menhaden fishery has some advantage over competitors in the relative uniformity of the commercial catch. There are only a few commercially important species of menhaden caught in the Atlantic and in the Gulf of Mexico. Just what bearing those variations have upon the products produced is virtually unknown. It is established that variations do exist between fish meal and scrap, solubles, and particularly fish oils, produced from different kinds of fish. Even greater differences result when cannery and filleting by-products are used as a source of raw materials. In the latter instances, it seems equally true, that excellent products are produced, each with its own set of advantages.
2. Effect of size, condition and food supply of the fish: It is well known that composition varies with the size of the fish, thereby influencing the properties of the final products. Changes that occur in fish from the time caught until they are landed and processed also bear upon the make-up of the products produced. The food supply of the fish influences the end result, as evidenced by recent work on herring, indicating that rapid softening sometimes results from a diet rich in certain forms of copepods. It is suspected that at times this also occurs with menhaden. Also, it is known that composition of fish varies with seasons, locality, and as a result of climatic conditions. These and many other factors are beyond the control of the fisheries. Such natural and unavoidable variations that bear on the quality will have to be measured and taken into consideration in promulgating quality standards.
3. Processing variables: These are numerous, but fall under such general categories as:
   a. Unloading of boats, involving variations in unloading gear, kind of water used in flooding holds, extent to which pump liquors are recirculated.
   b. Raw box conditions, involving such factors as extent of bacterial contamination.
   c. Cooker conditions, involving variations in amount of condensate, product temperatures, mechanical treatment received by raw material, extent to which cooker liquors are drained.
   d. Press conditions, involving press speeds, product temperatures, pressure obtained.
   e. Dryer conditions, including throat and stack temperatures, product temperatures, moisture differentials entering and leaving dryers.

f. Scrap shed, grinding and bagging techniques, including methods of turning scrap piles, heating of scrap piles, oxidative changes, fineness of grind, moisture differentials.

g. Oil house procedures, including all of the processing variables that occur during centrifuge or settling tank operation, tanking of oil.

h. Solubles plant procedures, including methods of preserving stick water, product temperatures during storage, acidification during storage.

Consideration of these factors indicates the difficulties of laying down quality standards. Requirements for any product must rest on a proper regard for manufacturing variations.

Every industry approaches the subject of quality standards with trepidation since at first glance it appears to be a leveling process classifying the best manufacturer with the most mediocre one capable of barely meeting requirements. The fallacy of the argument is best demonstrated by examining the hundreds of industries which presently produce raw materials and products described under some form of quality standard. In almost every instance the result has been to improve the status of the industry, to establish better trading rules and to eliminate shoddy products offering unfair competition. There is little evidence to support the contention that standards tend to destroy individual initiative, or to rule out added profits resulting from the introduction of quality factors beyond those described in the specification.

As the result of a code suggested by the California Hay, Grain, and Feed Dealers Association and by the California fishing industry, some sardine plants are producing meals of greater uniformity. Prior to development of the code, variation in the protein content between bags in a single lot might be as much as ten per cent. This code might well be a starting point for the menhaden producers and buyers. The proposed code, with some minor changes, is as follows:

a. Uniform grind, light color, and protein content per lot: Differences between lots, in grind and color, are not desirable. The protein content of individual bags within a certain lot should not vary over a range greater than 5 pounds of protein per 100 pounds of meal.

b. Maximum particle size: All particles should pass a No. 7 Tyler standard screen or a U.S. No. 7 standard screen, and 98 per cent of the particles should pass a No. 9 Tyler standard screen or U.S. No. 10 standard screen.

c. Moisture: An average moisture content of eight per cent, with a deviation not greater than plus or minus two per cent, is satisfactory.

d. Fat: The content should not exceed ten per cent, and preferably not more than eight per cent. A high fat content increases the hazard during storage.

e. Labelling: Statements appearing on the tag are the manufacturer's responsibility. The tag should have on it the name of the manufacturer, brand name and analysis required in the state into which it is being shipped. In this regard there is an urgent need for standardization of analysis requirements among the various states.

f. Weight: The sack should contain not less than 100 pounds on the standard moisture basis.

g. Bag size: To facilitate piling the bags, use one size of bag in any given shipment.

h. Sterilizing: Used bags should be cleaned and sterilized in order to prevent the spread of communicable animal diseases.

i. Preventing damage: Use "temporary car doors" to protect the bags against damage when car doors are opened.

It is freely admitted that these quality standards are not the ultimate from either buyer's or seller's standpoint. However, they are the best we have available at this time and, more important, they are in actual day to day use in the industry. As further research develops more refined standards, the California standards can serve as a foundation to which the refinements can be added.

Turning to the problem of fish oil, we note that in former years the soap industry consumed almost the entire production of menhaden fish oil. This is not true today since synthetics and detergents have made great inroads in the soap market. Unlike other commodities, the price of menhaden fish oil is not governed by the law of supply and demand. It is governed more by the price of its competition, vegetable oils and oils from other sources. In the past few years European markets for menhaden oil have played an important part in supporting the price, in that it has taken great quantities of available menhaden oil off the domestic market. The European market for fish oil is based almost wholly on the use of fish oil for human consumption. The Germans and Dutch seem to be quite clever, as are the Norwegians, in deodorizing and processing fish oil into oleomargarine. One factor which might affect the sale of fish oil to processing plants in Holland and West Germany is the political situation. If political considerations dictate a restriction on dollar spending or exchange, then this market would probably quickly switch to the Sterling area and buy African fish oil. With an expanding European population, all getting hungry every day, it would seem reasonable to expect this market to continue consumption of our fish oil.

The pressing problem in the marketing of menhaden fish oil is to find a greater domestic usage, particularly making use of such unique properties as its high percentage of long chain fatty acids and its high degree of unsaturation. These properties, particularly in a low cost raw material, are of tremendous interest to research chemists. At present, their ability to use fish oils is reduced by insufficient knowledge of its chemical structure, methods of deodorization and lack of uniformity of the product. New chemical compounds and extended use in the applied fields will arrive when our fund of knowledge increases. Fortunately, it is possible to say that extensive research is now under way that will enable us to know more about this product and what to do with it. In addition to these newer approaches to the utilization of fish oil there can undoubtedly be an expansion of some of the older and better known uses. The ability of fish oils to "wet" rust and thus to penetrate to sound metal, and to form flexible films which expand and contract with heat, will continue to be interesting properties to the protective coatings industry.

Fish oil continues to have potential value as an energy ration in poultry feeds in that it decreases dustiness in feeds, thereby reducing wastage, it improves palatability and it improves texture and appearance. Research is now being conducted to determine the limits that can be used in poultry feeding and this work is also expected to bring forth some improved formulating techniques.

Leaving fish meal and oil, we turn our attention to condensed fish solubles. The most important marketing problem in solubles has been an increase in production without a corresponding increase in demand. There are too few

feed companies that have facilities for using this material as a liquid. Dried solubles, or mixtures thereof, undoubtedly help widen the market. Concentrates made from large amounts of fish solubles are one way of getting the product to a larger number of feed manufacturers. Return of a part or all of the solubles to the press cake or meal is another way, and certainly an excellent means, of improving the nutritive value of fish meal, as well as an excellent outlet for sale of fish solubles. Here again would enter the problem of seasonal production of fish meal. Many buyers who prefer whole meal want this product all year around.

Although there is little problem in storing condensed fish solubles, and not too much difficulty preventing separation if adequate mixing facilities are maintained, it is still a variable product. Its nutritional value is said to vary considerably. Also, the need for careful plant control is brought out by the records of a large feed manufacturer which showed samples taken from various cars to vary in fat content from a low of 0.95% to 19.9% and in moisture content from a low of 39.3% to 53.0%.

There are many problems to be solved in the menhaden industry, but extensive work is under way, not only within the industry but under the direction of the U. S. Fish and Wildlife Service. The Government program has included the establishment of two sizeable research programs dealing with "Quality Index for Fish Meal" and an even larger one on fish oil. The "Quality Index for Fish Meal" research program is intended to untangle many of the complexities involved in producing and in measuring the quality of fish meal. It involves collection of fish meal samples produced under controlled and well defined conditions. These samples are checked for performance in feeding tests to determine their relative quality and are then subjected to extensive chemical investigations. The feeding work is being done at the University of Delaware, the University of Wisconsin and the University of California, while the other phases of the work are being done in Service laboratories located at College Park, Maryland and in Seattle, Washington. Well known universities are participating in the chemical studies dealing with proteins, liquids and growth factors. Extensive work on oxidative changes in fish fats is being done at the University of California. Basic research on the structure of fish oils and the chemistry of odor is under way at Hormel Institute, University of Minnesota, while some of the nutritional characteristics are being investigated at University of Connecticut and University of Oregon. This does not describe the entire program, but only such phases that apply to improvement of quality. Other phases of the fish oil research program deal specifically with applied research. The finding of new uses for fish oils in as short a time as possible is the objective of this portion of the work. Florida Southern College is engaged in an investigation concerning agricultural uses of fish oils in insecticides and fungicides. The University of Cincinnati is handling a project concerned with uses of fish oils in the leather trades while resin uses of fish oils is being investigated at Arthur D. Little, Inc. These and other studies which result in more varied uses for our products are capable of solving marketing problems resulting from insufficient outlets.

Industrial fishery products will continue to improve. However, the attitude of the menhaden products buyer of today is definite; they want quality menhaden products, all year-round. Consequently, the emphasis of the menhaden processor must be on the quality of his product and the ability to keep the customer supplied. If these factors are maintained, there is no doubt that menhaden products will find a ready market.

Marketing And Market Promotion In The Fishing Industry Of The Netherlands

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THE FISHING INDUSTRY in the Netherlands does not yet occupy the place it deserves in the national economy. This is due partly to the aftermath of the second world war when attention could only be given to supplying fish as quickly as possible to the undernourished population. Besides, it was more or less a tradition to ship the fish landed by the Dutch fishing fleet without further delay to those regions where the demand was great, and therefore little was done in the preparation and the preservation of the product. The result was that too little attention was given to research in the techniques of preparation and packaging.

Although the marketing set-up has been modernized considerably, especially as far as the domestic market is concerned, these conditions have had a restraining influence on the development of the fishing industry, particularly with regard to marketing.

The following figures will give some idea of the scope of fish production in the Netherlands:

In 1954 the supply of fish received from Dutch fishing vessels amounted to 395 million pounds, at a value of 19 million dollars. The supply from coastal fishing was 208 million pounds, valued at six million dollars.

In the same year exports (exclusive of fish meal) amounted to 348 million pounds at a value of 28 million dollars.

The principal Dutch supply port of fresh fish is Ymuiden, where the fish is marketed and sold at an auction organized by the Government. There, the fish are selected carefully before buyers make their bid according to the system called "Dutch auction." The wholesalers maintain storage space and offices in the auction buildings.

The Government collects a commission from the seller (shipowner) and from the buyer (wholesaler). The total amount of these revenues, together with dock-dues, etc. is about sufficient to cover the expenditures, so that in the last years—taking into account the necessary depreciation on the buildings, harbors and other plants—this enterprise has resulted in neither profit nor loss for the Government.

Scheveningen is the most prominent port for salt herring. Here the fish are sold at a municipal auction. Other important landing ports are Vlaardingen (for herring), Breskens and Den Helder for coastal fishing and shrimp, while Ierseke is the center of oyster and mussel farming.

Since the auction at Ymuiden begins as early as seven o'clock in the morning, the fish which is sold there is, as a rule, on its way to the stores—either in its original state or filleted—or to cold storage by or before noon of the same day. Because the country is comparatively small the fish generally reach even the remote corners of the country on that same day, so that there is no need for freezing the fish before shipping.

Large quantities of fresh herring which cannot be disposed of on the same day are very often put in cold storage so that there may be a supply available in times of low production.

In spite of the fact that the people of the Netherlands, even those in the

Eastern and Southern provinces, do not live far from the sea, fish consumption is on a relatively low level. In 1954, the per capita consumption was 17¾ lbs., of which about 4 lbs. consisted of salted herring, 2½ lbs. fresh herring and 8¼ lbs. fresh fish.

Throughout the years, various experts in the fishing industry as well as Government agencies have been wondering why people do not eat more fish. The general conclusion was that the system of distribution could be improved, to get the fish to the smallest communities. The question has been raised whether attention has not been centered too much on production, as a result of which marketing and distribution problems have remained in the background.

As a rule, the retail fish stores buy small quantities at a time, in order not to be left with over-supplies of fresh fish. This in turn results in high freight rates from the port of supply to the place of destination, which makes the price of the fish too expensive. It often happens that price reductions at times of large landings do not have any advantage for the consumers. Consequently, more effort is being put forth to encourage a larger consumption of fish.

Commercial advertising in the Netherlands does not have the facilities of television or radio. Television in the Netherlands started on October 1, 1951. The programs are supervised by the Minister for Education, Arts and Sciences, and are carried out under the joint responsibility of five broadcasting corporations. Although the Government sees a possible source of revenue in commercial programs, advertising is not allowed thus far. Just a few days ago a newly formed group of Dutch companies applied to the Minister for permission to set up Holland's first commercial television station. This proposal is under consideration, and will ultimately have to be approved by Parliament. Consequently, any advertisement of fishery products is thus far excluded.

At the present time, then, sales promotion for larger fish consumption remains limited to exhibitions, newspapers, magazines and displays sponsored by private business enterprises and Government agencies. In the framework of promotion much emphasis is stressed on the quality of the fish. Those in the fishing industry are aware that well equipped and modern fish stores and stands have favorable influence on sales. It would be ideal if fish stores could have their own cooling and freezing facilities but before we are that far advanced much has to be done. More up-to-date procedures in the preparation and packaging of fish are now being followed, and these developments point towards further promotion of deep-freezing of fish. In 1954 the number of shops which sell fried fish have increased from fifty-one to fifty-five and a further increase is expected, which shows that the consumer desires a ready-to-eat product.

Efforts to improve the quality of the fish must start with the fishermen, who have to be trained accordingly. To encourage the fishermen, the marketing board for fishery products gives awards each year to the skippers of vessels who—to the judgment of an advisory committee—have taken the best care in preparing a fine product during the season, and the Board also gives an award to the fish preserving factory which produces the best preserved product. A great deal of technical and scientific research has also been done in the field of quality control.

To stimulate the fish consumption throughout the country, part of the Moody funds, two million guilders, have been appropriated for the distribution of fish. These funds are used in granting credits to retailers for the purchase of deep freeze boxes and to equip a display center where housewives and others can become acquainted with methods of fish preparation, and where experts

give lectures on fisheries and on the distribution of fishery products. Also a mobile demonstration unit was set up, which makes it possible to distribute information to every part of the country.

Labor productivity in the Netherlands is, generally speaking, at a very high level. A shortage of labor has led to a more vertical investment (more capital per worker) as opposed to the earlier horizontal investment (capital to provide employment for an additional number of workers). It remains to be seen, however, to what extent the vertical investment can be applied to the fishing industry. The fact is that fishing is not a mechanized operation, and the fishing waters situated around the Netherlands offer only limited possibilities to the fishermen.

It is possible to determine fairly accurately how much fish is needed for home consumption, taking into account an increased per capita consumption, but the quantity to be exported remains more or less uncertain. The Marketing Board of Fishery Products—an agency of the Ministry of Agriculture, Fisheries and Food—has, despite this difficulty, set up a work schedule for the current year, listing the quantities of fish which they expect from the Dutch fishing fleet and the manner in which the fish will be used.

Production	Consumption			
	Preserved fish	Fish meal	Domestic market	Exports
120 million lbs. of seafish	7%	3%	73%	17%
8½ Million lbs. shrimp	—	—	40%	60%
187 million lbs. pickled herring and ungutted herring	—	7%	33%	60%
120 million lbs. fresh herring	30%	7%	27%	36%

These figures show that the fishing industry is greatly dependent on exports. These exports need not be reduced if the domestic consumption should increase, because there are still many fishing grounds which can be reached by at least part of the existing Dutch fishing fleet to increase the production. The aim is to strive for greater expansion and for an increase in consumption both in the domestic and the export markets.

In the present competitive American market the Dutch interests have to make use of all available devices to promote its fishery products. Although the cost of promotion in foreign countries is higher than in the Netherlands, the results in these countries are more rewarding. In several countries the Netherlands fishing industry has built a reservoir of goodwill, resulting in satisfactory trade relations.

In a country like the Netherlands where industrial expansion is further ahead than ever before in history, the modernizing of the promotion of fishery products is receiving special attention and shows great possibilities.

Can Natural Sponges Meet Competition from Synthetic Sponges?

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For thousands of years natural sponges have been an item of commerce in the Mediterranean world. Aristotle wrote of soldiers padding their helmets

with a "very fine, very dense, very strong" kind of sponge called "Achileion" and Pliny has written that the Romans used sponges for paint brushes and also used them with wooden handles for mops.

The use of sponges dates back to antiquity. Naked divers used heavy stones to reach desired depths and carried small baskets which they filled with sponges. According to legend, hundreds of divers were sacrificed in getting sponges for the baths of Livia, Messalina, and other Roman empresses, who were satisfied with only the finest specimens obtainable at the greatest depths. The sponge industry was spread by hardy Greek divers who went to all parts of the Mediterranean to harvest the crops growing in profusion on the bottom. Naked diving was the major method for taking sponges until very recently when diving equipment and the techniques of hooking were developed. Deep sea diving was first introduced into the Aegean in the 1860's and soon came into general use among the spongers.

These methods are standard practice for harvesting sponges both in the Old World and along the Gulf Coast of Florida. The development of the domestic sponge industry began in 1849 when the first shipment of sponges was made from Key West, Florida, to New York. These sponges sold at 10c per pound. They were considered by most buyers as of little value, since they were familiar only with the European varieties. However, out of this shipment developed the organized industry which thrived at Tarpon Springs and Key West up to recent years.

While the number of sponge species of commercial importance is limited, there are numerous varieties from different localities which are easily recognized in the trade and have special and sometimes valuable characteristics. There are only about thirteen species of importance.

Most of the 3,000 other species have characteristics which make them unsuitable for use by man, although there have been numerous attempts to find some use for these so-called worthless varieties. It is entirely possible that some may be utilized in the future.

There was no substitute for the natural sponge until the middle 1930's when the DuPont Corporation developed a synthetic material from cellulose. Since it was porous and had certain water holding properties they named the product a "Cellulose" sponge. Since that time there have been numerous products developed by the chemist which are made from a variety of materials. Since they are also porous and have some of the properties of the natural sponge they have also been called "synthetic sponges."

All of these products could be manufactured on a mass basis in an industrial plant. They were soon produced in large quantities and sold at low prices. However, they really did not establish themselves in the market until World War II. During the war most of the natural sponges were purchased by the Government and industrial plants as part of the war effort. There were insufficient domestic stocks to supply both this demand and that of the household consumers. Furthermore, the supply of Mediterranean sponges was reduced to a mere trickle. This left the consumer market open to the synthetic sponge producers and they were alert to exploit it. More and more housewives used these synthetic products and less and less natural sponges were seen in the hardware and drug stores of the United States. (Table 1).

Since the war natural sponge producers, distributors, and retailers have been plagued with another problem. During the period when sponges were doing war work, there were high hopes that they would be able to recapture their

place in the market as soon as the war was ended. But, as the result of intensive fishing, coupled with a blight which attacked the Gulf sponges on the beds in the late 1940's, the supply of domestic sponges declined. Synthetic producers had the field almost to themselves since the price of natural sponges became higher and higher as a result of the scarcity. Increasing prices of genuine sponges gave synthetics an even greater advantage.

The natural sponge business would be almost extinct today in the United States except for substantial imports from Cuba, and from Greece and other European countries. Table 2 shows that the imports of sponges rose sharply after the war and have continued at a relatively high level. Production from Florida on the other hand has been low since shortly after the end of the war. Fortunately for the natural sponge industry of the United States, there were enterprising dealers both in Tarpon Springs and some of the major cities of the United States who refused to concede that the industry must stop when the local stocks were not available, and they have sought elsewhere for supplies. Imports from Greece alone over the past five years have averaged over $1,000,000. While there have been considerable fluctuations in this source of sponges, brought about by all sorts of internal difficulties in Greece, the flow of sponges has continued and the supply of natural sponges today in the United States is still predominately from stocks originated in Greece and Cuba.

In 1950, in an address before this group, Dr. Richard A. Kahn of the U. S. Fish and Wildlife Service, laid down several criteria for the natural sponge industry to enable them to meet the challenge of the synthetic sponges. One of these was that a production of at least 300,000 pounds was needed, coupled with a decrease in price as production rose. Today domestic production is still only a small fraction of that figure, and the price is still proportionately high.

However, in the past nine months the reports from producers at Tarpon Springs have been more optimistic. Divers report considerable quantities of small sponges over the beds and the amount being landed has increased. The producers themselves are attempting to bring in about 100 experienced divers from Greece to replace the local divers who have become either too old or have drifted away from the business. They hope to increase the yield in this manner. It becomes increasingly important to push biological studies under these circumstances to avoid overfishing and a quick decline in a fishery which might be in the process of recovering.

Obviously then the production goal is far from being reached and, while the natural sponge is in a somewhat stronger position now than in 1950, the basic need for higher production is still the same.

Thus far, no one has been able to give a formula for bringing about this necessary increased production. We are looking to research to supply the knowledge which is essential to bring about recovery and then maintain production at a consistently high level. It has been heartening to have the Fish and Wildlife Service grant a contract to the Marine Laboratory of the University of Miami for biological studies of the sponge. Our only regret is that the amount is so limited that it may be impossible to learn enough to bring about the desired results.

As has been pointed out previously, the supply of synthetic sponges is almost unlimited. As their production has increased, the price has declined further, and this places the natural sponge in an even more difficult competitive position. This makes our problem a race against time so that our sponges can be

placed on the market before the synthetic domination is complete, and possibly it is already too late.

Dr. Kahn also pointed out the necessity of improved packing and grading, and proposed an extensive program of advertising. The industry over the intervening years has adopted these suggestions, with some success. First an attempt has been made to package natural sponges in attractively printed polyethylene bags and to get them out from under the hardware store counter into view of the prospective customer. Synthetics were already being wet-packed and packaged in attractive covers in 1950. In the last two years, the natural sponge distributors, through the Sponge and Chamois Institute, have instituted a uniform package and have devised a method of wet packing sponges which prevents the growth of fungi and molds, keeps the sponge soft and pliable so that it is not hard and harsh to touch, and practically eliminates any odor from the sponge.

Even though there is still a large spread between the price of natural and synthetic sponges, this simple procedure by the major distributors of sponges has met with considerable success. There has been an increase in the demand for the natural sponges, although an improper chemical formula for wet packing, which failed in some respects to meet the conditions listed above, slowed down this development. This aspect of the problem has been overcome by research at our Institute through the development of a new improved formula.

Some attempts have been made to advertise and promote sponges in the last five years, on an industry wide cooperative basis. In 1953 all distributors supplied identical "fliers" and point of sale material to their retail outlets. This first attempt was not highly successful because of limited funds, but it has led to more elaborate plans which are now being developed.

Grading of sponges is another problem of importance. For each species there are about four different grades for each size. With four sizes commonly sold, there are sixteen different grades for each kind of sponge. In the past, grading has been done by individual selection on the part of the foreman in charge of the packing shed. Sometimes when orders have been presented for a grade that is in short supply, lower grades have been substituted. This practice in itself has made for confusion and further difficulties in establishing standards, even though the Bureau of Standards has long maintained standard sponges for the various grades. Funds to study the grading of sponges have been granted to the University of Florida from the Fish and Wildlife Service. The industry hopes that out of this study will come a logical set of recommendations for grades and standards.

Until very recently the trend in sales of natural sponges has been downward, while that of synthetic sponges has continued to rise. For the first time in four years, there has been a slight rise in the sales of natural sponges, in 1955, even though there appears to have been no corresponding drop in the sales of synthetics. This upward change has been attributed to the industry-wide packaging program, although there may be some other factor which is operating. In any case, since 1951 the industry has tried to analyze its problem and take positive steps to meet its needs. Forward steps have been taken in packing and advertising and even greater efforts are planned.

Even though there are numerous pitfalls awaiting the natural sponges industry, the natural sponge can and is meeting the competition from synthetics. As time goes on and production increases, there is every reason to believe that more sponges can be sold on the United States market with resulting benefits to

the entire industry, from the diver who goes down in the depths to harvest the crop to the retailer in Butte, Montana, who sells sponges to local garages to wash cars.

Our industry has tried to analyze its problems. We have been making serious efforts to tackle the obvious defects in the business. Our efforts are beginning to show results although the key problem of increased production has not been solved. We may have to wait several years for further biological information.

TABLE 1.

COMPARISON OF PERSONAL INCOME WITH SALES OF NATURAL SPONGES IN THE UNITED STATES DURING THE PAST TEN YEARS

YEAR	*INCOME** (billions)	*SPONGE SALES*** (per cent)
1946	178.0	100.00
1947	190.5	70.2
1948	208.7	63.1
1949	206.8	54.4
1950	227.1	56.1
1951	255.3	52.6
1952	271.2	44.0
1953	286.1	42.1
1954	286.5	37.0
1955	292.3	38.6

*From Economic Indicators, April 1955—84th Congress, 1st Session, prepared for the Joint Committee on the Economic Report by the Council of Economic Advisors, Washington, 1955.

**From statistics compiled by SCI—confidential data converted to percentages to show trends. Highest year is 100%.

TABLE 2.

COMPARISON OF DOMESTIC PRODUCTION WITH TOTAL IMPORTS OF NATURAL SPONGES FOR THE LAST TEN YEARS

YEAR	*TOTAL IMPORTS*		*DOMESTIC PRODUCTION*	
	Pounds	Value	Pounds	Value
1945	95,596	791,979	266,600	3,003,897
1946	328,307	3,087,963	222,438*	2,945,962*
1947	214,198	1,768,130	126,091*	1,246,244*
1948	355,026	2,587,336	85,545*	465,938*
1949	268,055	1,936,974	68,700*	470,703*
1950	369,775	2,329,108	22,000	130,500
1951	281,645	2,166,123	15,800	110,755
1952	191,776	1,295,935	25,000	142,100
1953	284,362	1,628,192	17,327	128,003
1954	191,107	1,124,113	15,185	120,738

(1) From Report No. FT 110, U.S. Imports of Merchandise for Consumption Bureau of the Census.

(2) From Fishery Statistics of the U.S., Fish & Wildlife Service except *which are statistics on Tarpon Springs Sponge Exchange and thus slightly lower than total U.S. production.

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DISCUSSION

Marketing Session

Discussion Leader: L. W. Strasburger

Discussion Panel: Charlie Bevis, Spenser A. Larsen, James Barr, E. A. Fieger

The Government's Place in Market Promotion of Fishery Products

Donald Y. Aska

Q. H. Taylor: Mr. Aska described the rather elaborate efforts of the Fish and Wildlife Service to promote the sale of surpluses of haddock in New England and the somewhat less elaborate efforts to promote the sale of tuna. Another paper described federal government sponsored activities to help the sale of mullet. So the government is obviously intervening in the interests of a particular fishery and a particular group of fishermen, instead of allowing the law of supply and demand to solve these problems in due time. Is it the philosophy of the federal government to attempt to market each of these products when the inventories get to be troublesome? This is a broad question of philosophy which I believe to

be important. It has been shown that the per capita consumption of fishery products in the United States has not increased significantly in latter years. Therefore, the increase in the sale of haddock will have to result in the decrease in the sale of some other fish in some other part of the country. I would like to hear Mr. Aska's comments on this subject.

A. Aska: The position of the Fish and Wildlife Service with respect to the fishing industry is considerably different from that of the Department of Agriculture with respect to the farmers. We have no support prices, no subsidies, no acreage allotments—in fact no financial grants whatsoever to any part of the fishing industry. We feel that we have a responsibility to the fishing industry to help distressed segments. Our overall objective is to increase the per capita consumption of fish, and help to distressed segments is only a temporary measure.

Q. H. Taylor: Has increased sale of haddock and tuna resulted in decreased sales of other fish?

A. Aska: We do not have the information to answer that accurately. It may well be true that these increased sales have been at the expense of other fishery items. Justification for the haddock program can be further made by pointing out that the situation of the haddock market represents a serious threat to producers of other New England species—ocean perch, cod, etc. By stepping in, the Fish and Wildlife Service may quite possibly have averted a break in the market which would have affected not only the haddock producers, but these other people as well. Our overall program is to increase per capita consumption of fish, and these isolated projects—haddock, tuna, mullet, etc.—are all steps in this direction; so are our institutional and school lunch fish promotion projects.

H. Taylor (Comment): Since the per capita consumption of all foods is constant, if we increase the consumption of fish, we must do it at the expense of some other food item. So we have different bureaus of the government competing with one another, all at taxpayer's expense, to increase the per capita consumption of its particular product.

Q. Larsen: I have no basic objection to bailing out certain segments of our economy by government action, but if this indirect subsidization is to be done, is not the government justified in demanding the high, standardized quality of product that compares with other products the government is subsidizing?

A. Aska: The session yesterday afternoon indicated the high interest in fishery standards. When we undertook these promotion campaigns we did it on the understanding that we would deal only with high quality products, and if second rate fish were put on the market then we would drop out of the program.

Q. Bevis: In the distribution of seafoods to the school lunch program, can you be assured of good quality fish?

A. Aska: This depends on the school lunch manager. This person will buy fish that fits his budget and menu, and he can insist on good quality. If he gets bad fish, this will influence future purchases.

Q. Strasburger: You have school lunch programs in 23 states, you said. Would you tell me how these are set up?

A. Aska: The school lunch program is organized in cooperation with the state school officials and we set up a schedule suitable to them. We will expand the program as we can add personnel and as more states want the program.

Steele (Comment): There has been concern expressed as to whether it was proper for the federal government, through its agency, the Fish and Wildlife Service, to concern itself with the expansion of seafood markets, particularly when a part of the industry was in a tight spot. The interest of the federal government should lie in sustaining the food supply of the nation. A great number of our agricultural commodities are heavily subsidized, but for many years the only real support which the fishing industry had was from biological studies. I have repeatedly heard subsidies suggested for the fishing industry, only to have the industry say that they do not want subsidies. Perhaps our failure to effect an increase in the per capita consumption of fishery products has been caused by competition from the other protein foods which are being subsidized by taxpayer's money. There have been many who have considered it all right for the federal government to spend money on biological research, but that promotional activities are wrong. Is it improper for the federal government to do biological research to bring back the California sardine, when this would help to create competition for the Maine sardine? I do not think we look at it that way and I think that we should consider the government's efforts in the promotional activities in the same way. I do not think the federal government has any place in the promotional business except on an emergency basis and I do not think that the Fish and Wildlife Service has any business in a continuous promotional program, except to help in the increase of the consumption of fish in general.

Florida's Fish Marketing Problems can be Solved

Barton A. Westerlund

Q. Larsen: Coming from Detroit I wonder why you singled out Detroit as being a particularly good market for southern fisheries products?

A. Westerlund: There has been an influx of Negro people to Detroit from the southern area and the Negroes are heavy consumers of mullet.

Bevis (Comment): Those of us in the business have recognized for a long time many of the factors that you pointed out in your paper this morning. We are very grateful for the fine work in this research on mullet, and I think you have very ably pointed out the problems in your paper this morning.

Q. Osterbind: I have been interested in this same problem for a considerable period of time and I think that the utility of the type of research that the Marine Laboratory is doing is that it produces information on the true characteristics of the market. We found in talking with individual producers that there was a wide diversity of opinion as to what the problem was. An accurate portrayal of the market situation will make the industry better informed and will show them how they should act on this information.

Q. Bevis: Do you think that the increase in numbers of retail chain stores is good or bad for the seafood industry?

A. Westerlund: The industry can take advantage of the super market trend. It is the coming merchandising device, as we know. However they do insist on a good quality fish and they frequently package their fish in cellophane wrappers. In order to advance sales in super markets the fishing industry should improve their merchandising techniques.

Larsen (Comment): If you look at industries which have had tremendous successes you will find that they have subscribed to the idea of a brand on the commodity. Then they advertise it. If they expect to do a volume business on it in mass markets, they must have uniformity of quality. The brand itself implies that. It seems to me that quality control is the only way in which you can establish a sound base for continued sales. When you have a quality standard then you can use advertising effectively and build one step upon the next.

Problems in Marketing Menhaden Products

EXTEEN CORBETT

Q. F. Taylor: What is the possibility of using menhaden as human food?

A. Corbett: During World War II the menhaden were used for human consumption in a small way. Some were canned in Fernandina. I believe that in the future it will be used again for human consumption, as it is certainly a good fish.

Q. Bevis: Why do you think menhaden activity in Florida has been on the decline?

A. Corbett: Maybe the temperature of the water or a lack of food in the area. To tell the truth, that is one question to which I would like to know the answer myself.

Q. Sahlman: I would like Mr. Corbett to tell the real reason. He knows what it is but has not answered it.

A. Corbett: I think what Mr. Sahlman is referring to is the water pollution. We know that there have been a good many small fish which have been killed by the pollution.

Q. Sahlman: We have had a tremendous amount of pollution around the Florida Atlantic coast and the south coast of Georgia. The young menhaden come into the rivers at this time of the year, and on certain days recently when a heavy pollution was turned loose from the pulp mills the shores were lined six inches deep with millions of the young menhaden.

A. Corbett: That is true. We talked to the officials of the mills and it just happened to be an accident at that time. Those "accidents" occur quite frequently.

Q. Robas: We do have a pollution problem at Fernandina Beach. We are faced, however, with some economic factors in that the paper mills are vital to the economy of our neighborhood. We are also faced with the problem that very few people know how to define pollution. We presume that these paper mills or cellulose mills are killing our fish because they put sulfate liquor into the water and the sugars and the sulfate liquors are absorbing the oxygen in the water and consequently the fish are dying of suffocation. I understand that the Sterling Drug Company has available for license a new process which uses the sulfate liquor from a paper mill. One of these installations is being put in a large paper mill in Norway and I presume if such a process is successful paper mills here will adopt it. I do not favor punitive legislation for any industry, the fishing industry or the paper industry. I think, however, that enlightened management and enlightened self-interest will in the course of the next few years solve a good many pollution problems. I am hopeful that our paper companies in Fernandina will eliminate the pollution.

Q. Osterbind: About thirty years ago there used to be a lot of fish put into commercial fertilizer in the Savannah area. Of more recent years I understand that that business has dropped off. We have a trash fish fishery in the Gulf and it has developed in a very short time into a sizable industry. Now the price of trash fish is rather low and I was wondering if in the future there is any chance that fish might again be used as an organic fertilizer?

A. Corbett: We do not manufacture fertilizer. A good many years ago we made acid scrap fertilizer from fish. Now it all goes into dried fish meal which is used as an animal food. It is still good as a fertilizer but it is much more valuable in feeds. We use only menhaden. At one time we tried taking some scrap fish from shrimp boats. We have not been successful along that line because of the fluctuating source of supply. One day they would have fish and then the next day they would begin to catch shrimp and they would not bring in the fish. Unless we can get a supply regularly it isn't worth our while.

Can Natural Sponges Meet With Synthetic Competition?

David H. Wallace

Q. Taylor: Could you explain further the cause of the decline in the sponge industry?

A. Wallace: I think that there are two causes for the decline of the sponge industry. First, there is the matter of overfishing, which was certainly involved in the Florida west coast fishery according to a survey made by the Marine Laboratory of the University of Miami. The other factor is this fungus blight.

Q. H. Taylor: Has the natural sponge industry attempted to develop new uses in order to meet the competition from the synthetic sponges?

A. Wallace: There have been attempts to exploit natural sponges in the fields where they had established a market and have concentrated particularly on the industrial uses of sponges. They are considerably used in the automobile washing business, and in all kinds of wall washing. One of the interesting uses is in the pottery trade where there is a lot of use of the sponges. There has not been a concentrated effort to exploit the consumers field except in a small way, because of the problem of having an adequate supply to meet the demand if it might be created.

Q. Osterbind: How do the producers know the normal channels of distribution that have been utilized so that when they have lost their markets under conditions such as those that have prevailed here, they know the most effective way to recapture those markets? Have analyses been made to demonstrate these special qualities of the natural sponges, either in the industrial use or in the consumer field, so as to compete effectively?

A. Wallace: After the Florida sponges have been caught and dried, they are placed in the Tarpon Springs Sponge Exchange where they are sold at auction to buyers, who are also to a large extent distributors, scattered in various major cities all over the United States. There are also some local packers in Tarpon Springs who are also buyers. They buy and then resell to distributors who are located in New York, Chicago, Philadelphia, Baltimore, St. Louis and various other major cities. These distributors have an organization selling to wholesalers in various parts of the country; the wholesalers then distribute directly to retail outlets, when they then go to the consumer. I think that the procedure for distributing the product has been thoroughly worked out over a good many years, and I do not believe that at the moment there are any particular missing links. There are always attempts by people to bypass one or another step in this chain, and I think that this is going on all the time.

About ten years ago the Sponge Institute hired the U.S.

Testing Laboratories to run a series of comparative tests, using various grades of natural sponges as compared to the synthetic sponges which were on the market at that time. The tests run included the major kinds of sponges compared with the synthetic sponges—rubber type sponges as well as the ordinary cellulose sponges. Those data have been the basis for some public information which we have been attempting to use in developing a program to enlarge our market.

Q. Osterbind: If our stocks recover so that we have adequate supplies, should we anticipate that the sponges will move through these channels you just described, or what will be the problem of getting these effectively into the market, in competition with the synthetic sponges?

A. Wallace: If we are successful in bringing back the natural sponge into the market, there is no reason to believe that it will not flow through the channels of trade which are already developed. If they do not, I think it would be an almost impossible job to try to set up entirely new channels and put the product on the market again. Frankly I anticipate that we are going to have a large public relations and educational job to do, and I think that all levels of the industry ought to participate in this program. I mean to participate financially, so that we can raise sufficient funds to do an acceptable job.

Q. Aska: This morning you mentioned a wet pack type of packaging. Would you please describe this?

A. Wallace: In 1950 the synthetic sponge people came out with what they called a wet pack cellulose sponge. It was a sponge which had been treated with a solution which made it soft and pliable all the time. It was then sealed in a polyethyline bag, heat sealed so that it was relatively air tight. The result was a sponge that was fairly soft, rather attractive in appearance and was accepted quickly by the housewife. The basic component of it was a glycole to keep the sponge soft. The formula which is being used by the natural sponge people now is different from that of the cellulose people. There is more of a problem in handling a natural sponge.

Q. Thompson: Does it seem reasonable that under our labelling regulations these producers of synthetics should be permitted to label their product sponges?

A. Wallace: I do not think it ever should have been called a sponge in the first place, and the industry made a serious error about fifteen or twenty years ago when the first cellulose product was put out and they attempted to call it a sponge. At that time I think it is entirely possible that the Federal Trade Commission might well have upheld a movement to halt the use of the name sponge because it has a very specific meaning. However, after long usage of the term synthetic sponge, the Federal Trade Commission now permits it, but

it is supposed to have on the label either synthetic sponge or cellulose sponge, describing the particular type it is.

Q. H. Taylor: What is the possibility of cultured sponges? The late H. B. Wilson, of the Zoology Department of the University of North Carolina, discovered many years ago that when a sponge is chopped up in little bits and put back in the water, each little bit would grow into another sponge. Does that not afford us the means of artificially growing sponges in any quantity when you say that there is overfishing?

A. Wallace: Not only is it practical to farm sponges, but it is being done in the Bahamas now, and they are using just the technique that you described. They are taking living sponges and cutting them into small pieces and then attaching them to some heavy material which holds them on the bottom. The sponges then continue to grow until they reach a size that is marketable. Right now, in the Bahamas, there are several thousand pieces of cultured sponges which are ready to be harvested. I do not know the reason why it has not been done on the west coast of Florida. It certainly is one of the things that the producers and the State of Florida should consider as a possible way of speeding up this recovery which is so important at the present time.

Q. Whiteleather: Has there ever been any thought given to shaping or to the artificial coloring of sponges to make them more attractive to the consumer?

A. Wallace: As soon as you start cutting a sponge to make it the shape of a block, as they are able to do with synthetic sponges, you begin to weaken the sponge very quickly. It is imperative for the strength of the sponge to keep it pretty much in the shape which it is grown. You can trim the sponge and shape it to some extent, but too much shaping ruins the sponge. There have been some attempts to dye natural sponges, and one firm in New York dyed considerable quantities about six years ago. They did not have much success. The people who buy natural sponges are used to seeing them in their natural color and they resisted buying these colored ones. This could probably be overcome and could be one of the ways to help improve sales.

WEDNESDAY—NOVEMBER 2

Chairman—HARRY F. SAHLMAN, *Sahlman Seafoods, Fernandina, Florida*

The Economic Research of the Fish and Wildlife Service under the Saltonstall-Kennedy Act, with Special Reference to the Gulf and Caribbean Area

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MANY ECONOMIC PROBLEMS of the fishing industry are being attacked by research made possible under the Saltonstall-Kennedy Act. One of the basic problems stems from the change of the wants of mankind and the changing methods of satisfaction of these wants. Starting from these basic problems, economic research can assist the fishing industry by studying the changes of consumer preferences for certain fishery products and by studying the processing and distribution and marketing conditions which prevail to satisfy these preferences. We can help the industry immediately by illuminating its industrial organization, the differences of labor, the influence of machinery and the influence of business management. The study of demand, supply and value, of the costs of production and distribution, of the equilibrium of normal demand and supply can help in giving industry guide lines to go on.

This paper outlines the main purposes of our economic research and indicates how the actual program has been formulated to follow the basic principles of economic science.

In staff conferences we discussed the "wants" mentioned above, and we came to the conclusion that we know very little about the wants of one large part of the population—namely those who eat in public eating places. Aside from surveys in two or three cities, fish consumption in public eating places had not been studied. There are about 400,000 public eating places in the United States and they represent a big market for fish. We set out to find something about this market for fish and fish products. In order to do this, a lot of field work was required and we decided to have most of the work performed by the Bureau of Census.

The Bureau of the Census undertook the survey of fish consumption in public eating places last May with the following objectives:

(1) To determine the form in which each species is purchased by public eating places, e.g., fresh, frozen filleted, canned or cured.
(2) To ascertain the factors which influence the use or non-use of the various forms or types of fish and shellfish by public eating places.
(3) To determine the source of supply of fishery products, sizes of unit, prices and other characteristics of purchases.
(4) To obtain opinions as to preferences regarding quality of fishery

products purchased, methods of cooking, methods of serving, prices of servings, size of portions, and comparative prices of fish and non-fish meals.

Apart from restaurants and other public eating places, there are a lot of institutions which regularly use large quantities of fish and shellfish. This type of mass feeding is usually referred to as "in-plant" feeding. It includes feeding facilities in schools, hospitals, factories, and corrective institutions as well as cafeterias in business houses and Government cafeterias. While the results of the public eating study are being tabulated, we are undertaking a smaller scale survey to find out how in-plant feeding institutions can make greater use of fish and shellfish. The fishing industry will be informed about the needs of hospitals, Government cafeterias, and penal institutions for fish and shellfish. Some interesting findings can already be released. We found, for example, that in federal penitentiaries about double the quantity of salmon is served compared to tuna and in-plant feeding places of the industry more higher priced fish are used than in the in-plant feeding places of colleges and schools.

We expect to continue these consumption studies made possible under the Saltonstall-Kennedy Act. The changing pattern in the household consumption of canned fish and shellfish and fresh and frozen fish and shellfish will be examined in the future years, and marketing conditions resulting from variations in tastes and eating habits will be given further analysis. Armed with these facts, the Service's market development facilities can often render special assistance to the industry.

Since the enactment of the Saltonstall-Kennedy Act, special attention has been given to segments of the fishing industry suffering economically from adverse conditions. These adverse conditions may be brought about by foreign competition or by sudden market gluts which lower the prices of fishery products to such levels that fishermen or vessel owners operate at a loss. Depressed prices may also be caused by over-expansion of capacity in vessels and plants. Depressed economic conditions are sometimes caused by abnormal production or processing costs, among which are labor costs, insurance rates, repair expenses, gear and net costs and expenditures for gasoline and diesel oil. All of these will be studied by the Service to determine ways to assist the industry.

The shrimp industry is one of the segments of the fishing industry which we are now looking into in order to find ways to improve economic conditions. In 1954, shrimp prices were very low. In 1953, wholesale shrimp prices for the 21-25 count frozen shrimp, Chicago, dropped 32 per cent in two months, from $1.11 to 75c per pound. The high prices were reached due to a shortage of shrimp. With increasing supplies, prices in 1954 declined still further from 75c to 50c. We were in the midst of this near catastrophe in the fishing industry in 1954, when the Saltonstall-Kennedy Act was implemented, on July 1st. The Service laid out a plan of action for assistance to the industry, including a survey designed to improve production, processing and marketing conditions. In order to carry out the survey job on many fronts at once, we let five contracts to assist us in this work, amounting to more than $50,000. They were the following:

First, a study on vessel and plant operating costs, by the Federal Trade Commission, providing for the analysis of 40 vessels and 10 processing plants. The operating cost in 1952, 1953 and 1954, and as far as possible in 1955, are

taken from the books of vessel owners and plant owners.

The second contract, undertaken by the firm Harwell, Knowles and Associates in Coral Gables, Florida, refers to the physical efficiency of shrimp vessels. This study has, among others, the following objectives:

(1) To determine the increase in catch per man-hour and per vessel-hour with improved vessel operations.
(2) To determine the cost advantages of recent devices, such as the shrimplupe, radar, ship-shore phone, fathometer, etc.
(3) To determine the most efficient method of heading, shelling, freezing and packing on board the vessel.

A third contract refers to the physical efficiency of processing plants. One of the purposes of the study is to determine possible improvements in efficiency of physical handling and processing equipment for each operation, including unloading from the vessel, handling in the plant, heading, sorting, shelling, canning, breading, drying, freezing, packaging and loading out. This study was undertaken by the First Research Corporation of Florida, Miami, Florida.

A fourth research contract was given to the Bureau of Business Research of the University of Miami to study the economic conditions of production and primary marketing of domestic shrimp. The contract provides that the final report should include, among other things, the following points of interest to the fishing industry:

(1) Determination of economic characteristics of the shrimp industry at producer's, processor's and primary distributor's levels, regarding the catch, utilization, capitalization, gear and machinery capacity, production adjustments to market changes and related factors.
(2) Description of open and undercover selling practices and sales arrangements by vessel owners, plant owners and primary wholesalers.

Finally, a contract was let with the firm of A. C. Nielson Company in Chicago on economic questions of merchandising as well as consumer preferences. This contract contains the following two assignments to the contractor:

(1) A sample survey of secondary wholesalers and retailers to determine the availability of fresh, frozen uncooked breaded, cooked breaded, and canned shrimp in principal United States markets.
(2) A controlled merchandising experiments of factors involved at retail point-of-sales, to determine the principal merchandising factors which influence retail sales of fresh, frozen, uncooked breaded, and cooked breaded, shrimp.

In addition, the study on the shrimp industry situation will contain a report from the transportation division of the Department of Agriculture on transportation rates, a study on time and motion on shrimp vessels, for which another contract was recently let with the First Research Corporation of Florida. There is an historical study on the development of the shrimp industry up to the current catches and the quantities of packaged or canned shrimp offered for sale including imports and exports. Finally, a study is included on the economics of the shrimp industry in the Latin American countries, especially on shrimp resources in Central and South America.

This research work undertaken under the Saltonstall-Kennedy Act runs parallel with the regular assignments of the Economics and Cooperative Marketing Section, which include the study of transportation problems in the fishing industry, the study of relationship of prices received by fishermen and prices

paid by fishermen in the main production areas, a study on the development of foreign trade, including tariff quotas, restrictions and other trade barriers imposed on the fishing industry in this country and foreign countries, a study on the development of cooperative associations, trade associations and unions in the fishing industries of the United States.

In addition, smaller research studies are undertaken as need and opportunities arise. For example, a study on consumer preferences for breaded shrimp and fish sticks recently was completed. This study was proven helpful to the industry to determine package sizes and price ranges for such package sizes. Some other contracts which were let by the Branch of Commercial Fisheries indirectly affect the Gulf and Caribbean area. One of these contracts is a study of the economic feasibility of freezing fish on the high seas. Despite the fact that this study is done in New England, the results will be useful for the Gulf and Caribbean area. Another contract, namely, the study of fishing craft hull and P. & I. insurance, was let with Boston University for the purpose of obtaining lower insurance rates and reducing damages. This contract was directly influenced by the Gulf and Caribbean area, especially Tampa and Brownsville where in recent years insurance rates rose to unusual heights.

We hope that the economic research program, as outlined above and as it will be improved in accordance with the needs of the industry, will help the industry and will lay the basis for future economic progress of the fisheries of the United States. The employees of the Fish and Wildlife Service do their research with their minds and hearts on a better economic future for the fishing industry.

The Economic Factors Of The Shrimp Industry Of The Gulf Coast Area

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THE BUREAU OF BUSINESS AND ECONOMIC RESEARCH of the University of Miami has been asked by the United States Fish and Wildlife Service to undertake an economic study of the shrimp industry at the primary level of production and distribution. While our investigation is approaching its final stages, it is not yet concluded and the following remarks about the economic problems of the industry must be taken as tentative.

Shrimp fishing is an old industry, yet there are probably few economic areas in which so little is known about the economic structure, problems and trends of an industry as shrimp fishing. The reason for this lack of factual data is to be sought in the substantial changes which the industry has recently undergone. Some of these changes parallel shifts that have occurred in fisheries all over the country. Some shifts are explained by local conditions and circumstances, but as a whole the most important of the trends in shrimp fishing are specific to this branch of fishing endeavor and nationwide rather than local. The rapid pace of technological development has a great deal to

do with these changes: the size of boats has grown, fishing trips have become longer, the equipment more refined. On the other hand the methods of preparing the fish for the market, of transporting it to the market, of storing it, and of distributing it have been improved and grown both more simple and more complex. The environment has undergone changes due to the rapid industrialization of the coastline, the expansion of sport fishing, and the changing standards of life and economic conditions of labor.

These technical and social shifts are alone powerful enough to shake the economic basis of the shrimp fisheries. The costs of production have risen and larger investments have created larger risks. The technical advances in processing, transportation, and distribution have altered the relation of the fisherman to his direct and indirect customers. The need for social cooperation and integration has been intensified.

Larger, however, have been the effects that have come from the biological and the cultural changes that affected fishing. Old shrimp beds have yielded less, new fish beds have been opened for exploration. The product itself has changed its aspects; once considered a luxury product, it has become an article of popular consumption. These changes, in turn, have effected shifts in the geographical location of fisheries, wholesale houses, and processors. They have deeply influenced the relationship of labor and management and have broadened the capital structure of the industry. But they have also provoked financial problems for the smaller operators, revolutionary changes in the price structure, and caused both extraordinary profits and extreme losses to a large number of operators in the industry.

Most of the changes are too new and trends too unstable for a full economic appraisal. However, a few trends seem to stand out so prominently that it may be possible at the present time to indicate their direction and evaluate their impact.

One such trend is the accentuation of demand for the product. We seem to be confronted with a long-range growth in the consumers' preference for shrimp. This trend has already propelled shrimp into the number one fishery product, dollar-wise. Unless all signs fail, long-range demand for the product would tend to exceed long-range supply and would perpetuate some of the problems that supply shortages have created with respect to the price structure. We may anticipate that this trend will spell price instability rather than stability in the long-range trend. Undoubtedly, there are favorable factors: The increased popularity of the frozen product, the improvement in the methods of handling and storing shrimp alleviate some of the problems of price instability; improvements in the methods of marketing, advertising, and using the product will stabilize the market at the consumer end and with restaurant users. On the other hand the problems of supply and its seasonal and geographic stabilization are far from a satisfactory solution. The economic problem of opening new sources of supply, of improving the catch on existing beds without destroying their biological and economic base will be present for many years to come.

If the supply problem spells instability of consumer markets for the future, it also prognosticates further geographical shifts of the industry. In the past the habitat of the industry has followed the habitat of the shrimp. We have observed shifts from the middle Atlantic to the South Atlantic, from the South Atlantic to the Gulf, etc., all the way down to the Mexican Coast. Fishermen have been uprooted from their old established locations; shrimp fleets have

become mobile; wholesale houses have sought new centers of distribution and even the processing industry has re-located—it is nearer the new centers of the industry. The chances are that this movement is by no means completed. The importance of some of the old market centers such as the Fulton Fish Market and the French Market in New Orleans are giving way to new price-registering places further inland and also nearer to the centers of production. The rise of the Mexican shrimp fisheries and the discovery of new shrimp beds in Central America suggest that international ramifications of the industry are likely to intensify.

Likewise, the internal structure of the industry which has been shaken loose from its traditional setup is likely to continue to manifest the symptoms of an industry in transition for many years to come. New forms of fishing have called for new forms of fishing organization. Gradually fisheries become both larger in scale of operation and larger in their capital structure. The ties between processors, wholesalers, and boat owners have become both more complicated and more integrated. The movement to larger concentration has been accompanied by the counter action of larger specialization. The fresh product, the frozen product, and the canned product tend to seek their own specialized ways of production and channels of distribution. At the consumer end the product is meeting with new competition of such products as fish sticks and other frozen foods.

Last, but not least, the fisherman himself finds that he is pulled out of his old way of living into new modes of bread-winning activity. The unions have become an important factor in some shrimp fishing areas. The higher development of fishing technology, the lengthening of fishing trips and the shifts in fishing bases have added new risks for the fisherman and have caused more exacting demands on his skills and capabilities. While financial rewards to the fisherman have tended to increase, the economic insecurity has not been substantially lessened. Boat owners likewise have been benefited by the rise of financial returns, but are faced with new problems in stabilizing their operations by better methods of management, new forms of marketing and sounder financial methods. Wholesalers have been exposed to the pressures of rapidly changing markets, fast depreciation and obsolescence of assets and financial risks in seasonal and cyclical market fluctuations.

As we look at the picture of shrimp fisheries as a whole, we see that the past years have vastly increased the total potential of the industry, offering the lures of a steadily growing consumer demand and rising production, but also threatening the industry with the tremendous impact of revolutionary changes in technology, production, marketing, and finances, and it is presenting to the industry a challenge of vigilance and financial preparedness.

The Post-War Demand For Fishery Products With Special Reference to Shrimp and Oysters

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DURING THE PAST 25 YEARS the fisheries of the United States have shown little evidence of growth other than that required to supply a relatively stable per

capita consumption of the products of the seas, and in general have exhibited a pattern of economic behavior quite similar to that of the economy as a whole. For an explanation of these phenomena we must look mainly to the science of economics rather than to biology. In recent years the volume of the total catch itself has varied closely with the concomitant changes in two economic variables, the average price per pound of fish and the annual value produced per fisherman. This is not to say that these two magnitudes cause the changes in the volume of the catch but the high degree of correlation between the three variables points to the importance of economic forces. In addition the fluctuations in both the "national income" generated by the fisheries and the value of the total fish catch follow rather closely the changes in the national income of the nation as a whole.

The history of the per capita consumption of fishery products is largely one of a stable level of from 10-12 pounds a year, interrupted by depression and war. The consumption per person was 10.5 pounds in 1930; this figure fell to 8.9 in 1932 and then rose steadily to 12 in 1936. The 1935-39 average was 11.1 pounds. The ordinary use of fishery products declined during the war because of the unusually large canned fish purchases for use by the military and for export to allied nations, but by 1946 the prewar consumption level had been approximately regained. Since that time the per capita figure has varied between 10.8 and 11.5 pounds. In 1954, it was 11.1, the same as the 1935-39 average. This is in contrast to the consumption of about 153 pounds of red meat in 1954, an increase of 22 per cent over the 1935-39 average of 125, and the growing consumption of other protein foods such as poultry and dairy products. While the difficulty of accounting for tastes or changes in tastes has become proverbial, attention may be called in passing to certain reasons for the failure of the per capita consumption of fish to follow the same trend as that of other important protein items. Two such reasons are the inability, or at least the failure up to the present, of the industry to set any standard grades for fishery products and the difficulty, due largely to extreme perishability, of maintaining consistently high levels of quality.

As has been noted before, the fluctuations in the national income generated by the fisheries follow rather closely the changes in the total national income (Figure 1). During the war years of 1941 through 1944 the national income which originated in the fisheries lagged somewhat behind the growth in total national income, however. This was true in spite of the fact that the growth in the value of the total catch of fish was almost exactly at the same rate as the increase in the aggregate income figure. The explanation lies in the fact that the terms of trade, that is, the relationship between the costs of what they buy compared with the prices received for what they sell, turned against the fisheries slightly during the period in question. This change was due almost entirely to the increases in costs, both absolute and relative, of food, fuel, ice, boat supplies, repairs, maintenance, and gear that the fisheries purchase from other industries. The costs of such items increased to as high as 47 per cent of the value of the catch in 1943, whereas they averaged only about 37 per cent before the war.

Between the end of 1944 and the end of 1949 the value of the aggregate catch of fish increased much more than the total national income, without any marked change in volume or composition of the catch. At least a partial explanation of this fortunate turn of events may be found in the relationship between fish prices and meat prices. After the end of the war the ratio of fish

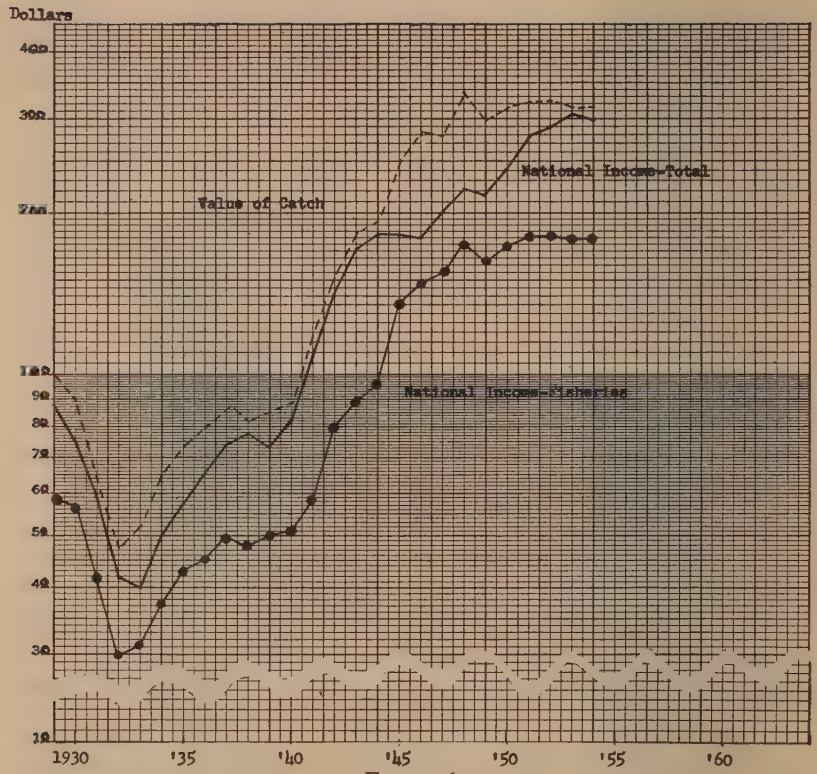

FIGURE 1

prices to meat prices declined markedly (Table 1). In other words, during the postwar period the prices of fishery products advanced, but not as fast as the prices of meats, so that there was probably some substitution by consumers of the former for the latter. The shortages of meat at the artificially held low prices during the war may also have been another factor affecting the consuming habits of the public in the direction of increasing the demand for fish. After the end of the war, also, the terms of trade turned back in favor of the fishermen, in that the cost of purchases from other industries became a smaller percentage of the total value of the catch. As the result of all of these factors the part of the national income generated by the fisheries gained relative to the totals for the entire economy (Figure 1).

These same phenomena are reflected in the average income per person of the proprietors and employees in the fishing industry as compared with that of these same groups in the economy as a whole (Figure 2). During the war the increases in the incomes of the fishery people lagged behind those of proprietors and employees in general, but during the postwar boom the relative position of the former improved until it was somewhat better than before the war. Although it is still too early to assess all of the forces at work, the fact that in the last two or three years the relative position of the fisheries has deteriorated somewhat may be attributable to the operation of economic forces

TABLE I

INDEX OF RETAIL PRICES OF FISH, MEAT, AND ALL FOODS, AND FISH/MEAT PRICE RATIO
U.S. 1939-1953 (1935-39 = 100)

Year	*Fish*	*Meat*	*All Foods*	*Ratio* $\frac{Fish}{Meat}$
1939	101.0	96.6	95.2	105.1
1940	110.6	94.4	96.6	118.0
1941	124.5	106.5	105.5	116.8
1942	163.0	122.5	123.9	133.0
1943	206.5	124.2	138.0	166.2
1944	207.6	117.9	136.1	175.9
1945	217.1	118.0	139.1	183.8
1946	236.2	150.8	159.6	149.0
1947	271.4	214.7	193.8	126.2
1948	312.8	243.9	210.2	128.2
1949	314.1	229.3	201.9	137.0
1950	308.5	242.0	204.5	127.5
1951	352.0	274.6	227.4	128.2
1952	344.2	273.6	231.4	125.8
1953	328.2	258.7	230.0	126.9

Source: U.S. Department of Labor, Bureau of Labor Statistics.

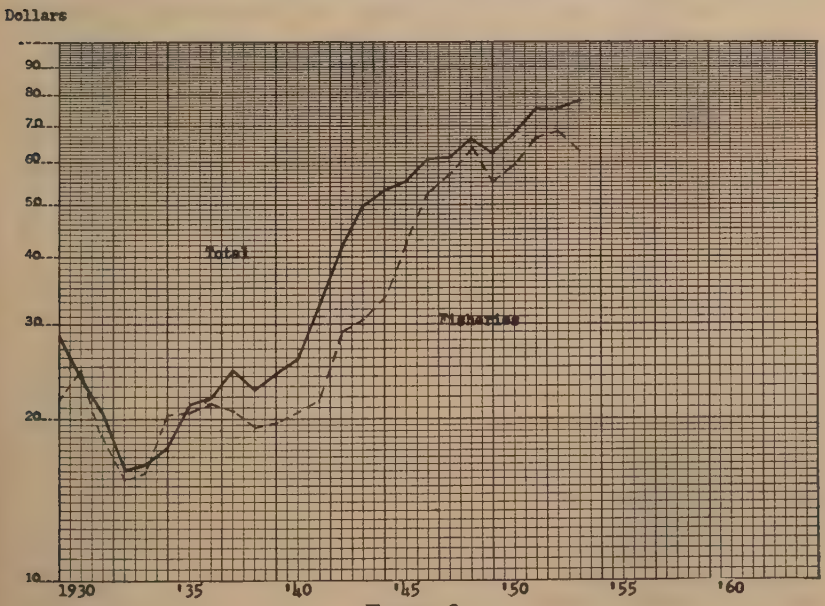

FIGURE 2

to cause a return of the fishing industry to its pre-war relative position. Other factors working toward this same end may be the decline in meat prices since 1951 and the growth of imports of fishery products. In any event, by 1953 the income elasticity in value terms of the demand for fish (increase in the total amount of money spent for the item as compared with the increase in total disposable income) had become slightly lower than that for food in general and for meat, after being consistently higher than that for the other two types of food during the previous post-war period. Looking at these matters in a different way it can be said that over the years, in spite of all the dislocations of depression and prosperity, war and peace, economic forces operated to allocate sufficient economic resources to the fisheries to produce the quantity of product that could be sold at prices which would keep the chief recipients of income in the industry, the proprietors and employees, in approximately a constant position with respect to real income relative to the economy as a whole. From a biological point of view it is interesting to note that over the years economic resources have been attracted to the industry without any clearly discernible declining trend in physical productivity per fisherman.

If the type of analysis sketched here in broad outline is valid, two practical conclusions logically follow.

(1) There is as much need for economic research pertaining to the fisheries as there is for biological research; and

(2) If the rate of growth of the fisheries industry is to be increased, considerably more resources will have to be devoted to demand-creating promotional activities than in the past.

For a number of reasons it is interesting and informative to analyze the postwar demand for oysters and shrimp against this general background of economic conditions in the fisheries as a whole. Both of these items have shown a favorable income elasticity of demand relative to that for other foods in recent years and of course the increases in the demand for shrimp have been little short of sensational. The oyster, moreover, is more subject to production control by man than most marine species, and perhaps is potentially important as a product of South Atlantic and Gulf fisheries. Shrimp, of course, is currently the most valuable single marine product of the South as well as of the nation as a whole.

The long term trend in the production of oysters has been definitely downward. This is true in spite of increasing population and improving standards of living in this country, and is in rather sharp contrast to the trend in the production of red meat (beef, pork, veal, lamb, and mutton). Oyster production declined from about 108 million pounds in 1920 to about 66 million in 1950, while meat output increased from approximately 15 billion pounds to 22 billions over the same period. The decreases in the oyster harvest have occurred at the rate of about 1.5 per cent a year on the average during the period since 1920, and the deviations from this average were fairly great only during the worst years of the depression of the 1930's.

There is fairly strong evidence that this long term trend is a reflection of a gradual but steadily lessening demand for oysters prior to World War II. In that period the reduced production had not forced prices up significantly as would have been the case if demand had remained approximately the same.

After the entry of this country into World War II a whole new set of economic forces came into play.

It is not possible to assign any definite reasons for the slackening in demand for oysters between 1920 and 1940. It is probably true that biological scarcity or natural depletion of supply is not sufficient alone to explain the decline in the consumption of oysters, although it should be pointed out that absolute shortages or difficulty in obtaining an economic good may cause consumers to become weaned away from it. Similarly, it may be argued that the high costs of production, especially labor costs, due to the inability of the industry to mechanize, may reflect back through high prices not only to reduce the amount of the product purchased immediately but also, from lessened use, may change the habits and tastes of the consumers. In other words, in some cases supply factors and demand factors are interacting, and a reduction in supply for whatever reason may in turn react to reduce demand. Another way in which supply factors may have affected demand is that the preoccupation with production problems which has prevailed in the industry in recent years may have reduced the amount of selling effort exerted. In many cases it has been relatively easy to sell the limited supplies available at acceptable prices without vigorous selling efforts.

Other speculative reasons for the probable downward trend in demand are: increased competition from shrimp, crabmeat, and lobster for the cocktail and society trade; replacement of *table d'hote* menus by *a la carte* menus in the better restaurants; the harm which typhoid scares of the 1920's did to oyster sales; and the growing popularity of other "snack" items, such as the hamburger and the hot dog. The demand for oysters as an item of diet is based largely upon their distinctive flavor and the opportunity they afford for variety, since they are not an economic source of animal proteins. It is true that the oyster is a balanced food in the sense that it contains all three types of foodstuffs, carbohydrates, protein, and fat, but it has less than half of both the caloric value and the protein content of beef (380 compared with 919 calories to the pound and nine or ten per cent protein against about 21 per cent). The oyster, moreover, has always been a rather high-priced food item, the taste for which is probably acquired.

Statistical investigations have shown that in the short run the price of oysters per pound of meats received by the fisherman in the postwar period is determined mainly by three factors: volume of production of oysters, the size of the total national disposable personal income (personal income after income taxes) and the price of meat as measured by the Bureau of Labor Statistics Meat Price Index. As might be expected, the greater the production of oysters the lower the price to the fishermen, but the greater the personal income and the price of meat the higher the oyster price.

One of the most important practical aspects of the nature of the demand for oysters is the relationship between the prices so determined and the quantities that can be sold at various prices. This is what is called the price elasticity of demand in economics. Several statistical analyses of different types have indicated that this elasticity in the case of oysters is less than unity. What this means is that if oyster prices decline the additional quantity that could be sold at the lower price would not be great enough to offset the decline in revenue per unit of sales and that the total dollar receipts of sellers at the reduced prices would be lower than before. Or, looking at the matter in a slightly different way, this means that if the oyster industry is to sell sig-

nificantly larger quantities of the product than at present on the basis solely of price competition for the consumer's dollar it will have to cut prices and costs rather drastically.

The long term downward trend in demand for and production of oysters seems to have been at least interrupted by World War II, especially during the period from 1942 to 1947 or 1948. The relative shortage at the artificially held ceiling prices of meat and other protein foods and the rationing of many of these items gave a fillip to the demand for fishery products in general and for oysters in particular. Some of this increase in demand for this relatively expensive product seems to be holding in the prosperous postwar period. The income elasticity of demand for oysters in value terms over the period from 1940 to 1952 is greater than that for food in general, for meat, and for fish in general, and is exceeded only by that for shrimp among closely competing products.

There has been at least a potential threat to this somewhat improved position of the oyster fishery since 1952, however, in that the competitive position of oysters with respect to prices, especially as compared with those for red meat, poultry, and fish, has worsened significantly. The Bureau of Labor Statistics price index number for oysters was 10 to 15 points higher than the corresponding combined index for meat, poultry, and fish during most of 1953 and 1954 after being lower than the latter through most of 1950.

The practical implication of all these facts is that if the oyster industry is to grow significantly something must happen, or be done, to increase the level of demand or costs of production and selling prices must be substantially reduced, or both. The best opportunity for reduction in costs lies in increasing the productivity of the oyster beds since the labor and indirect costs of production are determined largely independently of the industry itself, and are thus substantially fixed at any given time. While the productivity of the beds may be largely a matter of the technology and biology of oyster growth, consideration of the costs of producing shell stock involves also the factor of public policy as it can be shown both theoretically and empirically that the greatest value of product per unit of economic resources can be produced under a system of private property.

A private enterpriser who owns a plot of oyster bottom of, say, superior productivity would, of course, want to determine the optimum number of units of productive effort to be expended upon the resource. He would tend to increase productive effort up to the point at which an additional unit of effort would increase his income by no more than the cost of the extra productive unit. Or, in the technical language of economics, he would equate his marginal cost and his marginal revenue. In so doing he would maximize the "economic rent" or surplus of product over and above what inferior grounds would yield. Also, of course, he would realize an average return per unit of productive effort expended greater than the average cost of such units, or a profit over and above all costs, including a normal return on capital invested, and all wages including wages of management.

Under the institution of common ownership, on the other hand, oystermen tend to exploit the superior bottom first or more intensively than the others until its average productivity is reduced to equality with that of the next best ground. This process continues, theoretically, until the average productivity of all the plots has been reduced to equality. Competition among the fishermen would force this point of equality down until the returns just barely covered

the total costs of production. Thus the additional income possible under the institution of private property is dissipated under the system of common ownership. What is more, since under the latter there are no costs of growing oysters to the individual oysterman, there is nothing of an economic nature to prevent the fishermen from stripping the beds to such an extent that they cannot replace themselves. And of course no one has any incentive to plant or cultivate oysters, for he could not appropriate the harvest.

The empirical evidence in favor of private cultivation in the oyster industry is perhaps even more impressive than the theoretical. According to Galtsoff (1943), "The total acreage of oyster bottoms in our coastal waters can be estimated only approximately. According to present computations there are in the territorial waters of the United States about 1,428,400 acres officially designated as oyster producing bottoms. A small proportion of this area, not exceeding 185,000 acres of privately-leased or owned bottoms, produces 54.5 per cent of the total oyster crop. There is, thus, a very great difference in the productivity of cultivated and natural oyster beds."[1]

Such evidence of superior productivity could be multiplied many fold, but time prevents the citation of other cases.

The dynamic changes in the shrimp fishery of the United States have been so rapid and of such magnitude that a comprehensive, definitive, quantitative analysis of the industry as a whole is extremely difficult at this time. However, it may be possible to make certain useful observations and draw some meaningful inferences from the information available.

In contrast to the case of the oyster, both the domestic catch and the total supply of shrimp available for consumption have increased without serious interruption during the past 25 years at an average rate of about 5 per cent a year. During this period the industry has had a notable history of improvements in boats and gear and in production and handling technology generally. These developments were accompanied, of course, by numerous discoveries and subsequent exploitation of new shrimping grounds. An index of the increasing allocation of economic resources to the industry is to be found in the number of shrimp boats in existence—about 1700 in 1932 and over seven thousand in 1952—to say nothing of the growth of the size and value of these craft.

Although the production accomplishments of the industry have been truly dramatic, the really spectacular thing about shrimp has been the increase in demand. In spite of the expansion in supplies available, the level of demand has grown so rapidly that ex-vessel shrimp prices have increased more rapidly during the past twenty or twenty-five years than those of consumer goods in general, of food or fish in general, or of meat or oysters. These increases between 1932 and 1952 were, for example, shrimp—1065 per cent; oysters—469 per cent; fish—337 per cent; food—268 per cent; consumers' goods—194 per cent. Similarly the income elasticity of demand for shrimp in value terms has exceeded that of the other types of goods over this same period.

The increases in demand for shrimp have been associated with the growth in consumer purchasing power, social and institutional changes which have greatly increased the consumption of food away from home, and improvements in technology which have made fresh or frozen shrimp widely available

[1]Galtsoff, Paul, *Increasing the Production of Oysters and Other Shellfish in the United States* (Chicago: United States Department of the Interior, Fish and Wildlife Service, 1943.) Fishery Leaflet 22.

in consumer markets. Since shrimp is a relatively high priced food item, the growth in per capita real income in recent years was at least a permissive factor in the growth of demand. Until recently, moreover, the great bulk of the shrimp consumed was eaten in restaurants or other non-private establishments. The restaurant trade has done an excellent selling job on the product and this fact coupled with the changes in American life which have increased the practice of "eating out" has been another contributing factor to the growth in demand. There are no exact data available on the number of restaurant meals served or the volume of food consumed outside the home, but an index of such quantities constructed from the total expenditures on purchased meals adjusted for food costs shows an increase since 1935 much greater than that of the population of the country. The trend toward frozen shrimp has also contributed to the growth in demand in that it has made a quality product widely available in inland markets throughout the nation. The percentage of the total supply of shrimp utilized in this form has about doubled since 1945 and now makes up well over one-half of the total.

The importance of this tremendous growth of demand in relation to the production of shrimp is evidenced by the fact that while the production in pounds per productive unit in 1952 was only about 65 per cent of what it was in 1940 the value produced per unit was more than three times as great. In other words the industry continued to expand in spite of the diminishing catch per boat in recent years because the *value* of the catch per boat did not decrease.

The very rapid growth in the level of demand for shrimp has tended to obscure the normal relationship between prices and the quantities which could be sold at the various prices, i.e., the price elasticity of demand has been overshadowed by the almost continuous upward shift in the quantities that could be sold at all relevant prices. This fact makes the statistically determined demand and supply functions expressing relationships between prices and quantities unsatisfactory for some purposes. The tentative estimates that have been made from the demand functions calculated, however, indicate that while the price elasticity of demand for shrimp probably is greater than for oysters, it is still less than unity.

If this is true and if the general level of demand should stop rising, many of the implications of the inelastic demand for oysters might become relevant to the shrimp fishery. In a sense shrimp has been a new product—and perhaps still is—which has been in the process of being spread out over the entire limits of the potential market, both geographical and institutional. It would appear that now these limits are being at least approached and when they are reached, the industry will have to think in terms of marked cost and price reductions as the requirements for further expansion. Moreover, the extent to which the market limits can be pushed back will depend in an important way upon how much the home consumption of shrimp can be increased in the next few years. In this connection costs and prices will be significant factors along with the quality and convenience characteristics of the product.

Shrimp Vessel Efficiency Studies

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Recent statistics compiled by the U.S. Fish and Wildlife Service indicate that approximately 6,000 vessels of various types and sizes are engaged in the shrimp fishery in the South Atlantic and Gulf areas. Of these, about 3,000 were constructed since 1945. No changes have been made in the basic design of the vessels, although sizes have increased. New types of main and auxiliary engines, shafts, and propellers were installed; radio telephones, depth recorders, direction finders and auto-pilots become standard equipment on all vessels over 60 feet. Some have been fitted with additional specialized electronic equipment. New types of insulating material are being used for the holds, and new types of freezers are being used. Also there has been a tendency toward steel hull construction. There has been almost no research to determine either the contributions of the various pieces of equipment aboard a shrimper toward more efficient operation, or the cost advantages of this equipment. There has been no information available on what appear to be the structural and mechanical weaknesses in shrimp vessels which consistently contributed toward the reduction of effective fishing time, and increased the hazard of operation.

The purchase of a new boat (from $30,000 to $60,000, depending on size and equipment) obviously represents a large initial investment, with high yearly operating expenditures. The fixed costs of operation which are independent of the catch are determined by the efficiency of the vessel and the quality of maintenance. For example, a Tampa trawler, fishing Campeche during 1954, used $500 to $600 worth of diesel fuel and $300 worth of ice per thirty-five day trip, irrespective of catch or the price of shrimp. The expense of hauling, painting, repairs, amortization and depreciation, bear little short term relation to the yearly vessel catch and its value. In other words, the operation of a shrimp trawler is based upon a high fixed cost, resulting in great profits during favorable times and similarly large losses during recession. Under these circumstances, the need for maximum vessel efficiency and the economical operation is the key to profitable shrimping.

Many factors enter into the determination of what constitutes an efficient shrimp fishing vessel. Such a vessel spends a minimum of time idle at the dock or in the repair yards and is properly maintained. When at sea, it proceeds directly to the fishing grounds, and spends a minimum time en route to and from the grounds. On the trawling grounds, when under the command of a good skipper and crew, the efficient vessel will keep its gear in operation for the maximum time. The gear will also be attended to and last longer. Biological factors being equal, an efficient vessel then produces a high catch at low unit cost.

The various activities engaged in by the shrimp vessel are outlined in Table 1. The relationship between the various factors determining vessel efficiency can be visualized best from Table 2.

To isolate the vessel efficiency from the biological, human and weather factors, it is necessary to reduce the latter elements to constants. These can be approximated by selecting vessels fishing similar grounds during the same

TABLE 1
BREAKDOWN OF VESSEL TIME

Vessel Time	Time at Sea	Fishing	— Income
		Anchored	
		Running	
	Time at Dock	Unloading	Expense
		Refueling	
		Icing, etc.	
	Time under Repair	Ways (hull)	
		Engine	

periods of time with crews of nearly the same experience. In similar fashion, the human elements can be isolated by equating the vessel, biological, time and weather factors.

The objectives of this short, six months, study made for the U.S. Fish and Wildlife were to determine the breakdown of vessel time for vessels operating out of eleven major shrimp ports, analyze their catches, fuel and ice consumption, and relate these to the construction of the vessel, the equipment aboard, and the crew.

Field work included coverage of eleven ports ranging from Atlantic Beach, N.C. to Brownsville, Texas. Early work on the project indicated that in order to obtain the information necessary, the number of vessels to be surveyed would have to be increased from the original thirty. The sample was therefore expanded to seventy-one vessels. Even this number is small compared to the 6,000 vessels operating in the fishery. Consideration of the many fields encompassed by vessel efficiency, the many areas to be covered, and the time restrictions imposed by the amount of contract funds, much of the work should be regarded as background material, requiring further research, using larger samples, and perhaps concentrated in a smaller area. In the opinion of the authors, the present data form a basis for a comprehensive study in this field.

Breakdown of Vessel Time

Table 3 shows the time breakdown for vessels operating from various areas.

Much of the vessel time at the dock is essential for loading, unloading and routine maintenance of the vessel. Vessels fishing the Campeche banks from Tampa, Fla., make the most efficient use of vessel time, with less than 25 per cent spent at the dock. Actual fishing time for the Tampa fleet is almost identical to that of vessels fishing local grounds from Key West, Fla., to Biloxi, Miss., and Brownsville, Texas. To be able to spend as much as 25 per cent time fishing, the Tampa vessels must spend a greater amount of time at sea. Therefore, their operations are the most vulnerable to depression of shrimp prices or reduction of catches. This is emphasized by the fact that most of the Brownsville fleet fished the local grounds in 1954 when catches on the Campeche banks were reduced.

At first glance it appears that Key West, Tampa, Biloxi, and Brownsville vessels spend much (30-35%) non-productive time at sea. However, the crews are small, with two or three men per vessel. If fishing time of nine to twelve hours per night is considered together with the additional time spent

TABLE 2

FACTORS INVOLVED IN VESSEL EFFICIENCY

POUNDS CAUGHT—VESSEL	*X*	*CREW*	*X*	*BIOLOGICAL FACTORS*	*X*	*WEATHER AND OCEANOGRAPHIC CONDITIONS*
	Hull: Construction, Dimensions, Power, Ice and Fuel Capacities, General Design	Captain: Initiative, Experience, Age, Race, Owner or Hired		Abundance, Availability, Size Count, Depth Fished, Seasonal Variation		Hurricanes, Rough Weather, Harbor Conditions, Tides
	Auxiliary Equipment: Generators, Battery, Winches, Booms, Cables, Pumps	Crew: Number, Experience				
	Navigational Aids: Loran, Direction Finder, Radio Telephone, Fathometer, Automatic Pilot, Fischlupe, Radar					
	Fishing Equipment: Net Size and Type, Mesh Size, Doors, Cable Arrangement					
	Port and Repair Facilities: Ways, Dockage, Net Repairs, Electronic Repairs, Engine Service					

TABLE 3

HOUR AND PER CENT BREAKDOWN OF VESSEL TIME

FISHING DIFFERENT GROUNDS OUT OF DIFFERENT PORTS.

Fished out of:	*Area Fished*	*TIME AT DOCK*		*TIME AT SEA*					
				Running Time		*Fishing Time*		*Non Productive T.*	
		Hours	*%*	*Hours*	*%*	*Hours*	*%*	*Hours*	*%*
Rockville, S. C.	Offshore	7275	83.0	228	2.6	1257	14.4	0	0
Thunderbolt, Ga.	Offshore	6139	70.1	219	2.5	1751	20.0	651	7.4
Mayport, Fla.	Offshore	7033	80.3	314	3.6	1413	16.1	0	0
Key West, Fla.	Tortugas	3529	40.3	458	5.2	2180	24.9	2593	29.6
Tampa, Fla.	Campeche	2175	24.8	1195	13.7	2246	25.6	3144	35.9
Biloxi, Miss.	Offshore	2940	33.6	567	6.5	2248	25.6	3005	34.3
Brownsville, Tex.	Offshore	3391	38.7	192	2.2	2220	25.3	2957	33.8

heading and icing the catch, little time remains if the crew is to obtain an adequate amount of sleep. Some of the more ambitious crews make or mend nets during this free time. Others fish for snapper or grouper with hand-lines. At present, the fish houses handling snapper and grouper discourage the production of fish on a part-time basis by the shrimp vessels.

To determine why repairs are necessary, a study of damage and claim records for shrimp vessels was made during the period between 1952 and 1955 from insurance company files. A summary of this information shows that the accidents can be divided into two general categories: a) those due to the negligence and errors in judgment of the captain or crew and b) those due to mechanical failure of the vessel equipment. Some of the latter may be attributed to poor maintenance of the equipment by the crew or by shore personnel.

About 28 per cent of the accidents reported in the files made available to the investigators were the direct result of human error. Many of the mechanical failures may have been avoided had proper preventative maintenance been practiced. About 13 per cent of all accidents resulted from careless or inexperienced vessel handling and were avoidable. A proper crew training program could, perhaps, have reduced the incidence of this type of accident.

About 20 per cent of all mechanical failures were attributed to reduction gear and clutch mechanism failure. Hydraulic clutches appeared to be less vulnerable. The weakening of rudder fastenings, perhaps by electrolysis and the disablement of the steering mechanism, caused about 17 per cent of accidents. Of five fires, three were caused by inadequately protected exhausts and two by faulty wiring. Four accidents were associated with inadequate anchorage. Two breakdowns were caused by water in the fuel.

Many of the above accidents, which resulted in large claims to the insurance companies involved, might have been avoided with systematic inspection and maintenance of the equipment. A check list for captains and shore mechanics is suggested as an aid in this direction.

Hull Construction

Until the discovery of the pink shrimp grounds off the Dry Tortugas and Campeche, Mexico in 1950 and 1951, most vessels were built by shipwrights scattered along the coastline. Construction was slow but apparently quite thorough. The sudden demand for more and larger vessels requiring increased financing developed a new trend in the industry. In ordering a vessel the fisherman gave foremost consideration to the delivery date, financing, and price of the vessel. To meet the problem of rapid delivery and low construction costs a number of yards started to mass produce vessels. Hundreds of vessels were constructed in spite of the shortages that developed in skilled shipwrights and various kinds of lumber used in boatbuilding. The importance of regular vessel maintenance cannot be overestimated. The best constructed vessel will deteriorate rapidly if not attended to.

Navigational and fishing aids, electronic devices such as radio-telephones and depth recorders were evaluated. Radio transmitters usually range from five watts output to the maximum permissible of 150 watts. Some sets are increased beyond this point. In many cases the sets aboard the vessels are inoperative, at least part of the time. One of the main reasons is, apparently, that the 32 volt bank of batteries is charged by generators and voltage

regulators that are set to cut out at about 36 volts. This constant overload on the electronic equipment shortens the life of the tubes, resistors, and condensors in the sets. The introduction of rheostats in the system added to this problem as captains, in attempting to increase the power of their signal, turn up the rheostat, and, of course, contribute further to the voltage overload.

Interviews with radio technicians revealed that many radio-repairmen attempt to fix sets with which they are not familiar. In addition, there are, reportedly, captains and crew members who try to repair the equipment themselves and further aggravate the condition of the set. It has been reported that inadequate copper wiring, insulation, copper-grounding, aerials, and improper crystals are common in the fleet. It is believed by technicians that many of the sets operate at about 50 per cent below their theoretical output.

The depth-recorder is one of the most useful tools in increasing the efficiency of vessel operation if full advantage is taken of the recordings. The author's personal experiences, combined with interviews held during the current survey, indicate that many captains are not well instructed in the care and use of the device. A tendency exists among many captains to use the recorder intermittently to conserve recording paper, thus defeating one of the more important functions of the instrument, that of detecting rough bottom where gear will be lost. Recently "Echographs" of German manufacture have been installed aboard some shrimp vessels. These have proved to be superior to other similar products.

The above were examples of the type of information which has been obtained.

Productivity

We investigated the productivity of various grounds when fished by various vessels. The number of vessels surveyed was relatively small and figures are therefore of general interest only. A study of the catch per night fishing indicated that the vessel success depends to a large extent on the season and grounds fished. For example, two 67 foot vessels fishing half the year at Tortugas grounds, and half at Campeche, caught 261 and 267 pounds per night. The same sized vessels fishing only Campeche grounds during the year caught 30 to 80 pounds more per night fishing. Vessels of the same size, fishing the Brownsville grounds, caught an average of 278 to 417 pounds per fishing night. Forty to fifty foot vessels fishing the Mayport, Fla. grounds all year round caught 65 to 97 pounds per day while the same class of vessel fishing from Rockville, S. C. caught an average of 172 to 197 pounds per day. In this case, the latter vessels were more highly powered. (See Table 4.)

TABLE 4

RANGE OF CATCHES PER DAY/NIGHT IN VARIOUS AREAS DURING 1954

Port	*Grounds*	Catch in lbs. (headless) *Jan.-Apr.*	*May-Aug.*	*Sep.-Dec.*
Thunderbolt, Ga.	local	——	119-169	184-328
Key West, Fla.	local	150-222	144-177	203-285
Biloxi, Miss.	local	70-124	313-330	180-244
Brownsville, Tex.	local	142-288	248-342	483-651

Engine Power

The importance of power was investigated. Five larger vessels, each powered by a total of 330 horsepower, were compared with a similar number of vessels of the 67 foot class, powered by a total of 170 horsepower. The catches for Campeche ranged from 415 to 496 pounds per night, headless, by the larger vessels, while the lower powered vessels had catches ranging from 291 to 342 pounds. These were non-owner vessels. A captain-owner with a large vessel powered by 330 horsepower produced 725 pounds, while a similar smaller vessel with half as much power produced 278-417 pounds per night. Higher production does not mean that they operated more efficiently or economically.

Most of the vessel owners interviewed agreed that the skill of the crew was the most important single factor in obtaining efficient vessel operation. They claimed that owner-operated vessels, as a rule, fished more days per year, thus increasing their catch, and had lower maintenance costs through proper handling and care of their gear. This is borne out by the fact that the smallest vessel of the group with the least horsepower, but owner-operated, produced the best total catch per night in a certain area.

Comparisons were made of fuel consumption by Key West, Biloxi, and Brownsville fleets. The lowest daily fuel consumption was recorded by the Biloxi fleet, the highest by Brownsville. It was of interest to note that the Brownsville fishing vessels used nearly twice as much fuel as the Key West vessels, even though the engines used were similar. Shrimp production in the Brownsville area was considerably higher, however, thus nearly equalizing the cost of production. Apparently the vessels fished harder and/or more efficiently.

In conclusion, our preliminary survey indicates that improvements in vessel maintenance will increase the life of the vessels. A detailed study of this complex problem of design and construction would point out to the prospective vessel owner what to demand in construction, the hull shape and power best suited for shrimp fishing. It is also felt that in order to obtain a comprehensive picture of the efficiency of the different elements in the vessel, one important fishing area be selected for detailed study. Records for several years should be obtained on more vessels to confirm the indications presented in this paper.

A Study of the Efficiency of Domestic Shrimp Processing Plants

EARL T. VAN SCIVER

Executive Vice President, First Research Corporation, Miami, Florida

THIS WORK, carried on for the Fish and Wildlife Service, is specifically an industrial engineering survey, designed to check the efficiency of operations and processes in shrimp processing plants throughout the United States. The project, along with a similar one which First Research Corporation is carrying on aboard shrimp fishing vessels, is an integral part of the over-all Fish and

Wildlife program designed to shed light upon the wide varieties of methods used in shrimp processing and, where possible, to suggest improvements which would increase the efficiency of shrimp processing and in turn reduce costs and increase profits on shrimp products at this level.

The results of these studies will be released through the Fish and Wildlife Service when the study has been completed, but a brief outline of the work done and the benefits which may be anticipated from this study are in order.

Our field work has carried us from the Atlantic Coast areas in Morehead City, in Thunderbolt and Brunswick, Georgia, through Jacksonville, Key West and Tampa. In Louisiana, we have studied plants in New Orleans, Harvey, Westwego, Houma, Dulac and Chauvin. In Texas, our work has carried us to Harlingen, Port Isabell and Brownsville. In our studies aboard fishing vessels, our engineers have worked out of all of these areas and have spent a number of days in the Campeche fishing grounds. In all, we have made comprehensive studies in some fourteen processing plants and have observed operations in some twenty-five plants, in order to get the most comprehensive coverage possible. In terms of products, our studies have included breaded shrimp, canned shrimp, cooked and peeled shrimp, fresh shrimp, dried shrimp and fresh frozen shrimp.

As one might expect, one of the more difficult problems in a study of this kind is that of gaining entry into these individual plants and finding the proper people at hand with whom to discuss the various problems. In some areas, we have received excellent cooperation and a definite willingness of plant owners and operators to cooperate to the fullest extent in giving us details of their operations. In other areas, we have found some decided reluctance to reveal any information concerning operating characteristics and details of the business. We, of course, have kept completely confidential our findings made in the various plants concerned.

Our procedure in following through these studies has involved a combination of depth interviewing techniques, with detailed time studies of operations and an engineering investigation of equipment and processes.

The first step in a typical plant study consists in interviews with the plant managers or owners. This has generally taken the form of a general discussion of problems and methods, with particular orientation to the drawing out of any new ideas or new methods being tried out or considered, or any new ideas or methods about which the plant manager or owner may have knowledge over and above our own. This technique has led to some fertile fields of investigation and analysis.

The second step has consisted in a thorough study and delineation of the actual operation of the plant itself. This includes, for instance, a study of the floor plan and the operational flow of all materials. This study of operation and flow, with each operation fully described, has been put into graphic form, to be included in the study.

The next step in the plant study includes a comprehensive analysis of all processing methods, whether they be machine or hand methods. In each case, the operation is described in complete detail; the operating characteristics, production rate and efficiency of each machine or hand method is studied and fully described, so that it may be compared in cost and effectiveness with operations found in other plants.

Time studies are made of each individual operation, particularly hand operations which we find to be generally in use throughout the plants we

have studied. Time studies of machine operations are, of course, also included.

The next step is a depth discussion with floor supervisors on production methods and problems. Again, this depth interviewing technique has drawn out some unusual ideas and suggestions for improvement of processing methods and operations which will be valuable to this study.

As a fifth step, each item of productive equipment is thoroughly investigated from an engineering standpoint. We have, in most cases, contacted and discussed with the manufacturers of equipment the technical details of the machinery and have also discussed with them any plans they may have for improvement or the development of new equipment to be used in this shrimp processing industry.

Our final presentation to the Government will include, in general, the following information: First, a case history of each individual plant studied, describing in detail all of our findings, including a description of processes involved and time values for all elements of production. Number two will be a general summary of each segment of the study, including breading, canning, freezing, or whatever the end product may be. In this summary the best features of production of each individual plant will be combined in what we will term a master or comprehensive report. This will be an integrated plan, making up what we consider to be the most effective operation attainable. Time values, comparing those of plants already in operation and of the ideal plant, will be presented, and this material will undoubtedly be valuable for individual plants checking their own operations against what we might term an ideal standard.

It is anticipated that this material will act as a base of fundamental information for manufacturers in the shrimp processing industry. There is no doubt in our minds but that individual processors, through ingenuity and inventiveness, may well improve upon any plant which we have studied and even upon our integrated ideal plant operation. On the other hand, it is quite possible that even the most inventive and ingenious may at some point have overlooked obvious and fundamental improvements in methods and operations. In obtaining a broad view of methods and equipment within their own particular field, some processors may well obtain ideas useful in their own plants. On the other hand, some may receive inspiration for further research and experimentation on their own.

We believe, too, that manufacturers of processing equipment may well find valuable suggestions for further research and development of equipment needed in the various processing methods.

Consumer Preferences for Breaded Shrimp

WALTER H. STOLTING

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IN 1948 BREADED SHRIMP PRODUCTS were introduced on a commercial scale for sale to consumers by enterprising processors of fishery products. These breaded shrimp products caught consumer acceptance very well and have since

increased in use. While their rise in volume of sales has not been as phenomenal as the rise which has occurred in the more recently introduced fish sticks, nevertheless, they are an important item in the fishery trade.

Last year 17 million pounds of breaded shrimp products were produced in the United States. This level of production was attained in 1952 and has since remained at approximately the same figure. The greater amount of this total annual production is of the uncooked variety. A few firms in the United States produce a cooked breaded shrimp product but this is a minor part of the total.

With the rise in the amount of commercial breaded shrimp products which occurred from 1948 to 1954 and also the more recent and more spectacular rise in the use of fish sticks, there developed a desire among industry and Government personnel to know more about the nature of consumers' desires for and use of these products. Such questions as the following were raised:

1. Do consumers who have served breaded precooked shrimp like them?
2. Has the use of frozen breaded precooked shrimp completely replaced the serving of other fishery products?
3. Has the use of frozen breaded precooked shrimp partly replaced the serving of other fishery products?
4. How much breading do consumers like on breaded shrimp?
5. What size package of breaded shrimp do consumers prefer?

Accordingly, it was decided in the Fish and Wildlife Service to conduct a survey of consumers to find the answers to these questions. In addition to the five listed above, quite a number of other questions were asked of consumers.

The persons who received and filled out the questionnaire which was developed for this study were predominantly housewives. All of the persons selected were members of two panels maintained by National Family Opinion, Inc. of Toledo, Ohio, the research firm which did the field work on the study. Each of the panels contained 1,000 members. A total of 2,000 questionnaires were mailed out to these panel members during the month of November, 1954, and 1,797 were returned for usable analysis. The households on the panels were selected to be closely representative of all the households in the United States. Certain controls were exercised in the selection of panels, so that each is composed of the same proportion of different classes of households as are existent in the makeup of all households in the nation. For example, approximately the same percentage of households will occur for each region as the percentage of all households in a region is of all the households in the United States. In addition, controls are exercised over distribution of the households among various sized communities, among various income groups for households and among homemakers of various ages. Thus the sample for this survey, as taken from the two panels, represents by judgment a close approximation of the make-up of all households of the nation.

It was found that only about one homemaker in five had served breaded shrimp during the year prior to November, 1954. Of those who had served this type of product, a high percentage of all homemakers trying either cooked or uncooked breaded shrimp become satisfied customers. Apparently the predominant marketing problem for breaded shrimp processors is to get consumers to try them, since such a small percentage of households have actually done so.

It is interesting to review the reasons given by respondents who did not try breaded shrimp products, to determine why they had not tried them. The

majority of such respondents listed no particular reason for both cooked and uncooked breaded shrimp. Of the remaining respondents who gave a definite reason, most stated they had a general aversion for such products or they preferred other types of fishery products. Only a minor percentage of the group indicated the products were not available and, what was most interesting, another small minority indicated that they had not tried such products because of price. While very few actually stated that price is not a major problem in getting people to try breaded cooked or uncooked shrimp, it is possible that of those who listed no particular reason many really were interested in price, since the survey indicated that breaded shrimp consumption is concentrated among middle and upper income groups. This would indicate that price does have some effects upon general use of the product.

It is notable that out of the households that had tried breaded shrimp a very high percentage liked the products in all communities in which respondents were questioned. In all groups over 85 per cent liked either breaded uncooked or cooked shrimp and in urban area communities of various sizes over 90 per cent liked the uncooked product.

It was also indicated that consumption of these products increase moderately as household size increases, and younger housewives bought breaded shrimp more than older housewives. Furthermore, families of white-collar workers used these products more than families of workers engaged in occupations requiring manual skills.

Household size was found to be related directly to the package size preferred by the housewife. Families of two persons prefer a 10-oz. size, whereas larger families, particularly those with four or more persons, would prefer a 12-oz. package if it would be available. It was also indicated that the latter type family prefers a somewhat smaller sized shrimp than the small two-person families, which preferred to obtain the very largest size of shrimp when buying breaded shrimp products.

Breaded shrimp consumption is concentrated in urban areas. Consumption in the cities is about twice as high as in rural areas. Among the cities consumption is slightly higher in the very largest cities as compared to the smaller ones.

DISCUSSION

Economic Session

Discussion Leader: HARDEN F. TAYLOR
Discussion Panel: DONALD MCKEE

The Economic Research Of The Fish And Wildlife Service Under The Saltonstall-Kennedy Act With Special Reference To The Gulf And Caribbean Area

RICHARD A. KAHN

Q. McKee: Would you explain further your statement that some of the Latin American countries would possibly be receptive to the U. S. shrimp industry operating from those countries.

It seems almost contrary to what I hear about extending territorial waters and not wanting us to go down.

A. Kahn: Some American enterprises are already established in Peru, Chile and Ecuador. We have two types of research in the South American countries going on. The first is biological and the second is to find out as much as possible about the production costs in these countries, compared with our production costs. Mr. Milton Lindnen, who speaks perfect Spanish and who is experienced in this type of studies, is stationed in Mexico City. From there he will visit all the countries and will report to us at Washington. We can publish the facts, and after that the industry has to find out how far they can exploit certain grounds which were found, and how far they can establish corporations in these countries.

Q. Ringhaver: How long will it take to complete the economic survey which you are working on? Is is possible to get published reports from time to time?

A. Kahn: Our contracts are set so that the last one will expire about the first of April, 1956, when we will start to write the final report. We hope to have it ready by the end of 1956 and we hope it will be considered the bible of the shrimp industry for many years to come.

Q. Ringhaver: Who will receive this information?

A. Kahn: This will be available to everybody as public information.

Whiteleather (Comment): This publication will not give all the individual data that is collected, but it will be a compilation of the data in such a way that the facts can be drawn from the data without revealing anybody's business.

The Economic Factors Of The Shrimp Industry Of The Gulf Coast Area

REINHOLD P. WOLFF

Q. Ringhaver: Does the growth of the shrimp fishery coincide with your theory of business in other fields?

A. Wolff: The shrimp industry is going through the same type of development as the poultry industry did back in 1880's, from an industry with a relatively low amount of consumption into an industry with a popular product. This is the same in many industries, where the price had to be brought down to the consumer level. Eventually the price of shrimp will have to also be in line with any type of commodity that has such widespread consumer acceptance.

Q. McKee: Do you believe that through increased production and exploration in foreign countries, that these imports will tend to dampen price fluctuations somewhat, and put stability in the market?

A. Wolff: The production of foreign countries, such as Mexico, naturally has a mitigating influence on prices in this country. On the other hand, the opposite result is possible. As soon as

demand slackens, you naturally have surpluses, and the Mexican product then will appear as a surplus product and will make things worse. There is actually a trend in both directions.

Q. McKee: I am not concerned with Mexican production. I am concerned about Pakistan and the areas of the Orient. It appears from reports that Pakistan would have very good shrimping grounds. I am afraid that with the lower labor costs we may possibly get into a condition such as the tuna fishery is in now. The Japanese were planning to go into Pakistan and help to promote the shrimp industry there. If they do that, the cost of production will be a great deal less than ours, and we can expect some difficulty. It could possibly parallel the tuna production. Essentially the cost of production is my main concern.

A. Wolff: Several countries are suddenly showing the possibility of enormous enlargement of the supply of shrimp. On the other side, we see that Europe is following the United States in developing into a great user of shrimp. That is likely to happen all over the world. Just as the American automobile has spread to all parts of the world, and probably the world at large will repeat other things that have happened in this country. There will probably be space in the world for American shrimp, for Mexican shrimp, for Pakistanian shrimp and for shrimp from many more areas of the world. We are dealing with potential demand for a popular food product.

Q. Bullis: Some day we might possibly get to a point where the world can be guaranteed a large supply of shrimp. Of course, as the demand grows more fishermen will go out to make a living catching these shrimp, but I gathered from your statements that you felt that demand could keep pace with whatever is produced for quite some time to come. Is that correct?

A. Wolff: That is correct.

Q. Taylor: As you know, a very large part of the fishing industry is characterized by unlimited competition because the natural resources are not subject to private ownership, and because a very large part of it involves very little capital investment, skill or knowledge. So it tends to become an industry of unlimited competition and is rewarded merely by a wage for labor involved, and very little return on capital, or very little enterprise. Do you find it true that since these vessels are now becoming so large, complicated and expensive that that very factor would tend to prevent the shrimp industry from degenerating into a profitless industry because of the element of protection that is afforded by the demand for large investment?

A. Wolff: We know from general economic experience that wherever an industry grows to use large amounts of capital, there is also the danger of cutthroat competition. There are quite natural limitations for unlimited competition by the very fact that you have to have capital now to operate profitably in this field.

The Post-War Demand For Fisheries Products With Particular Reference To Shrimp And Oysters

GEORGE M. WOODWARD

Q. Ringhaver: You mentioned that the consumption of fish in 1954 is similar to consumption in 1939, but that there is an increase of 22 per cent in red meats. I was under the impression that the per capita consumption of fish had been increasing in the past 10 or 15 years.

A. Woodward: The figure that I have available is 11.1 pounds of fish per capita in 1954, which is the same as for 1939. Of course there is an absolute increase in fish consumption in that the population has increased, but not a per capita increase.

Q. Taylor: With the growth of population in this country is the demand for oysters likely to be such that it can be supplied from natural wild oysters, or is it necessary that the production of the oysters on leased bottoms be increased?

A. Woodward: A great part of the oyster production comes from privately controlled bottoms now. We could not rely on public bottoms now to supply even the reduced amounts at the present time. Public bottoms, unless very carefully handled, are not very productive of oysters.

Q. Hoover: While it is true that the average fish consumption per capita in 1935-39 was 11.1, and the same in 1954, the kind of fishery products consumed was different, wasn't it? We know that shrimp has replaced oysters to a certain extent as a cocktail item. Do you have any breakdown on that figure?

A. Woodward: What you say is true, but I do not have this breakdown with me. Of course there are these shifts in demand, but the overall consumption apparently has not increased per capita.

A Preliminary Report On Shrimp Vessel Efficiency Studies

C. ISAAC CAMBER AND GORDON C. BROADHEAD

Q. Ringhaver: Did you give any thought to the number of pounds that have to be caught per year to have the boat at a break-even point?

A. Camber: Cost of operations, and break-even points were all handled by the Federal Trade Commission. We computed everything on the basis gallons, of pounds of ice, pounds of shrimp and hours of operation.

Q. Bullis: Do you feel that the establishment of minimal material and construction standards for boats would be justified?

A. Camber: This is not common now. As the industry progresses there will be a demand for standards to protect both the builder and the industry as a whole.

Ringhaver (Comment): The Coast Guard, insurance man and the dealer himself all have requirements as to the boats' construction and maintenance.

Q. Ringhaver: In the future, will you be able to give us the depreciation of these boats?

A. Camber: There are two separate depreciation rates. The engine is usually fixed as soon as something goes wrong, but the hull is overlooked as long as it is not falling apart.

Q. McKee: Do you make any surveys on freezer boats?

A. Camber: Yes, we surveyed the freezer boat, brine tank boats, and ice boats with different types of insulation. We checked a couple of freezer boats in Tampa and in Brownsville, and we analyzed several boats with brine tanks, two in Brownsville and one in Morgan City. The brine tank boats were able to pay for themselves in about two years. Several captains discarded the brine tanks, but those who kept up a good maintenance found that they got a better product.

Q. Morris: Did you find that many of the owners knew anything of maintaining their vessels? I find that maintenance as well as crew trouble is a big factor in the losses that we have in the fleet.

A. Camber: It works both ways. The owner-operator may try to fix something and aggravate the situation, while the company owner would get a mechanic to fix it. It is true that the captain-owner, being constantly interested in the boat, is aware of the problems and will notice little things that maybe a company owner would not know of. Of course, some companies have a mechanic who goes from boat to boat to check on the condition.

Q. Morris: In connection with training of crews, should not an educational program for owners and captains well be included?

A. Camber: Yes, I believe that one remedy would be check lists. I know of some companies that issued a check list to the captain, and he would have to check off anything that he found wrong with the boat, and would file a report at the end of the trip.

Consumer Preferences For Breaded Shrimp

WALTER H. STOLTING

Q. McKee: Do you feel that with the advent of home freezers that there will be a change in consumption in the rural areas?

A. Kahn: The present indications are that fish did not profit much from home freezers in the rural areas. It is up to the industry to see that rural markets have different varieties of shrimp products.

Q. McKee: Do you think that in the rural areas the competition for space in the freezer cabinet has prevented a complete line of shrimp products from being displayed?

A. Kahn: That may be possible. Some food markets refuse to handle fish or shellfish. They feel that the smell of this product may have an influence on the sale of other products. A good fishery product never smells, so it is also up to the industry to bring such a good fishery product into this area.

Q. Brawner: Don't you think also that the difference in the per capita income of the rural versus the urban individual partially accounts for the difference in the per capita consumption of shrimp, since it is a more expensive sea food product?

A. Kahn: We have found that comparatively low income groups buy a large portion of breaded shrimp, so I do not think that this is a decisive point. The decisive point is the availability of a good product.

THURSDAY—NOVEMBER 3

Chairman—JOHN ROBAS, *Fernandina Beach, Florida*

High Seas Fishery Management

WILBERT MCLEOD CHAPMAN

Director of Research
American Tuna Boat Association
San Diego, Calif.

A PRINCIPAL DIFFICULTY in speaking about the management of fisheries lying in the High Seas is that the high seas have to be defined first. The reason for this is that the body of law under which management is to take place is different on the high seas than it is in the territorial sea and the management must fit the body of law under which it is devised.

For the past ten years there has been a considerable amount of controversy as to what are the high seas and what is the territorial sea. The international actions on this issue have had a considerable effect on the thinking about the management of sea fisheries generally, because, although the diplomats and international lawyers are unable to agree as to where the territorial sea ends and the high seas begin, the fish are even more disagreeable. They move back and forth across political boundaries in the sea with impunity, the fishery follows the fish, and the management problem follows the fishery.

All of this has proven to be confusing to the diplomats and international lawyers, but they are hacking away at the problems involved —and one might even say with might and main. Some progress is being made. This has been particularly true in the past twelve months and will be true to an even greater extent in the next twelve months.

In 1947 Argentina proclaimed its sovereignty to the continental shelf and the epicontinental sea above it, together with islands rising from the shelf and the resources in the shelf and sea. So far as is known no foreign flag vessels fish off Argentina to any noticeable extent and, as a matter of fact, the quite rich fishery resources off Argentina are only lightly worked by Argentinians who, up until the last few years, have been primarily beef eaters. Thus the claim had little or no fishery problem involved in it and was concerned chiefly with the perfection of Argentinian claims to the Falkland Islands, which are possessed by the British.

But this action pretended to extend the territorial sea of Argentina as much as 500 miles out to sea in certain places, because the shelf is broad off Argentina. What Argentina can do unilaterally any other country can do also by the same means, and the next to move was Chile. Chile could not use the same rational as Argentina did because along much of the Chilean coast the continental shelf hardly reaches out to the three mile limit. So Chile proclaimed sovereignty out to a distance 200 miles from its coast.

No foreign flag fishing vessels fished off Chile then or now, except for whalers, and none of those were American. Accordingly the United States

had no fishery problem vis-à-vis Chile or Argentina as a result of these proclamations. As near as can be estimated the practical cause behind Chile's proclamation was that the budding whaling industry of Chile, which is based on shore stations, found the conservation regulations of the International Whaling Commission onerous and had some vague fears of competition from the pelagic whalers of Norway and others. The only good way to escape from the regulations of the International Whaling Commission was to extend the territorial sea of Chile out far enough to cover the area where the Chileans whale. This would also serve to exclude the pelagic whalers and prevent their competing with the Chilean whalers if it could be made to stick. So it was done.

What is sauce for the goose is sauce for the gander. Peru has not got much of a continental shelf either, but whatever basis Chile had for claiming 200 miles of territorial sea, Peru also had, so in 1949 Peru published a similar proclamation. In 1949 no American flag vessels were fishing off Peru and the regulations of the International Whaling Commission were not bothersome, for the budding Peruvian whaling industry was largely ignoring them, as it has to date.

But in 1950 the tuna fishing vessels of California extended the range of their fishery down off the coast of Peru and they have been fishing there steadily ever since. Most of the fishery is out of sight of land and the Peruvians had not been using the resource, but most of the fishing is done within 200 miles of the Peruvian coast. Accordingly the American flag vessels were breaking Peruvian law by fishing without permission of Peru. They have continued to do so because the United States Government has continued to tell them they have the right to do so under international law and that the United States Government would protect the United States flag on the high seas, which it considered to start at a point three marine miles from land.

Here, then, was the seed for a first rate international imbroglio between the United States and one of its best friends on the South American continent. This was not a theoretical passing of proclamations and protests back and forth; it was a practical problem involving a good many million dollars worth of floating equipment owned by American citizens.

It should be kept firmly in mind, in what is said here, that the Peruvian government and people have acted in a thoroughly responsible, and even friendly, manner during the intervening six years. There have been no seizures of American tuna vessels on the high seas by Peru, and the Peruvian Navy has for the most part been thoroughly courteous and friendly in its relations with the tuna fleet. But the vexing problem of conflicting claims of sovereignty has lain like a smoldering fuse under the otherwise harmonious relations between Peru and the United States. If it were not for the tuna fishery, the argument could go on for generations without conflict, as many such sovereignty claims have done in the past few generations. But the tuna fishery operating day in and day out the year around in the disputed area can give rise on a moment's notice to incidents most damaging to the relations between the two countries.

So the two countries, as civilized nations, have moved their controversy into the United Nations in an attempt to solve it by peaceful methods. To the present date this has not been too successful, because there it has become entangled with a number of other fishery disputes between a number of other nations. Iceland is quarreling with the British and other European nations about the fisheries off Iceland. Yugoslavia and Italy are quarreling over the

fisheries of the Adriatic. Russia, Korea, Communist China, Nationalist China, Indonesia, Australia and India have a variety of fishery quarrels going on with Japan over a variety of fisheries ranging geographically from the Arctic to the Antarctic, and in both the Pacific and Indian oceans. Norway is a little fearful of Danish action in the Greenland fisheries. The Israeli and Egyptians are hassling over the fisheries of the eastern Mediterranean as they are over most things. Mexico and the United States have been arguing over the breadth of the territorial sea in the Gulf of Mexico since the Civil War.

Thus when the problem got moved into the United Nations level of action it got mixed up with other problems and, in order for a solution to be brought to it, a general solution had to be had under which the other outstanding conflicts over international fisheries could also be resolved. This is a Herculean task and it may not be possible of accomplishment in our generation; but a fair amount of progress has been made on it this past year, none the less. And in the international discussions which have taken place, certain general concepts have emerged which will act as guideposts to those industries utilizing the resources of the high seas.

The problem first was sent to the International Law Commission, which is a permanent body of independent experts on international law established by the United Nations to advise the Juridical Committee of the General Assembly on matters dealing with the codification of international law and its progressive development. At its first session in 1949 the International Law Commission began to handle this problem. It has been so engaged ever since. Its seventh session, in 1955, was almost wholly given over to the twin subjects of the regime of the high seas and the regime of the territorial sea. Its eighth session, in 1956, will be similarly so engaged.

In its fifth session in 1953 the I.L.C. quite frankly admitted that the fisheries part of this high seas problem covered a great deal more than international law. Conservation, a complicated technical subject in itself, was involved. The members of the International Law Commission were experts in international law and not in conservation. Therefore they put forward their recommendations on fisheries in a tentative way and noted that they would benefit from having the advice of conservation experts in this field. Their recommendations on fisheries drew little support from any of the nations on any side of the several fishery quarrels in the world. The General Assembly of the United Nations in 1954, therefore, took two actions:

1. It referred the whole problem of the regime of the high seas, the territorial sea, fisheries, and the continental shelf back to the International Law Commission with instructions for the Commission to have a full final report on the whole subject ready for the General Assembly in 1956, and
2. It resolved to have a world wide meeting of nations in April of 1955 on the subject of the "Conservation of the Living Resources of the Sea" which would have the purpose of advising the General Assembly and the International Law Commission on the technical aspects of fishery conservation and its implications on international law.

The world wide meeting on conservation took place on schedule in Rome this year. Forty-five nations were represented by voting delegations. Another six nations sent observers. A report was adopted which can be had by purchase from the United Nations in New York.

While this meeting was called for the purpose of defining what the objectives

of conservation were and how such objectives could best be reached in international fisheries, the meeting at all times was on the verge of breaking up in a fight over what nations should share in the benefits of the conservation work. The conference finally decided, by a narrow majority, that it was not competent to express any opinion as to the appropriate extent of the territorial sea, the extent of the jurisdiction of the coastal State over fisheries, or of the legal status of the superjacent waters on the continental shelf.

With this problem out of the way the conference then decided by a large majority (actually no one disputed it) that the immediate aim of conservation is to conduct fishing activities so as to increase, or at least to maintain, the average sustainable yield of products in desirable form, and that the principal objective of conservation is to obtain the optimum sustainable yield so as to secure a maximum supply of food and other marine products.

It then set forth the types of scientific information required for a fishery conservation program, types of conservation measures applicable in a conservation program, a review of international fishery conservation problems now being handled by international means, a list of those not yet being so handled, and some general conclusions that could be drawn from these international experiences.

Working on the basis of this final report of the Rome conference the International Law Commission, at its meeting in Geneva immediately after the Rome meeting, completely reorganized its articles on fisheries in the light of the recommendations from Rome. It put forward instead a new set of ten articles which it proposed as a complete mechanism for handling by peaceful means conservation problems that arose between nations in an international fishery.

This set of articles is by no means perfect and it is quite certain that they will be amended and perfected by the Commission next year in the light of comments received by the Commission from member nations. Nevertheless the framework here established and the principles set forth will undoubtedly be substantially retained in the final recommendations of the Commission. Accordingly everyone who fishes on the high seas should give these articles close study, for his operations will be affected by them sooner or later.

Essentially these things are provided:

1. Any nation can regulate its own nationals on the high seas.
2. When two or more nations are fishing together on the high seas and conservation regulations are needed they should get together and provide them.
3. In an emergency, a coastal nation can establish conservation regulations on the high seas applying to other nationals other than its own.
4. Any country, whether fishing or not, has an interest in high seas resources being properly conserved and can demand conservation measures being put into effect upon a showing that they are needed.
5. Conservation regulations so established should be binding upon all fishermen.

But all of these things are set forth within this framework of principle:

1. All nations have the right to fish on the high seas, not excepting those parts of the high seas lying over the continental shelf.
2. Regulations are necessary in order to provide the maximum sustainable yield of food or other marine products from the resource in question, and must be designed for this purpose and no other.

3. Regulations shall not be discriminatory against foreign fishermen.
4. Regulations have to be based on appropriate scientific findings.
5. If imposed by a coastal country there has to be a showing that the need for measures of conservation is imperative and urgent.

If any country whose nationals are affected by such regulations feels that these conditions have not been met, then it can request and obtain an arbitration of the question by an impartial arbitral board of experts chosen by the parties in dispute or, if they cannot agree, by the Secretary General of the United Nations. The findings of such an arbitral board will be binding upon the parties in dispute.

Such recommendations are far reaching. Something along these lines will be adopted by the United Nations in the course of time that will provide:

1. Nobody will be impeded in fishing on the high seas so long as he is not wasting a resource by over fishing or wasteful means of harvesting.
2. Over fishing and wasteful means of harvesting of marine resources will be prevented.
3. The food needs (but not necessarily the economic desires) of a coastal population will be given some degree of priority.
4. Very likely those fishermen who have been properly husbanding a resource on the high seas will gain a priority of use over new fishermen subject only to the prior sustenance requirements of a coastal population.
5. Adequate safeguards will be provided to prevent coastal countries from damaging the economic welfare of fisheries, and to prevent fisheries from damaging the productive potentials of the resources which they harvest.

All of this, of course, depends upon what are the high seas, and this was recognized by the International Law Commission. They did not completely solve this problem in this year's set of articles, but they dealt with it in a firm manner.

With respect to this vital question the Commission said:

1. The high seas is everything seaward of the territorial sea.
2. International *practice* is not uniform as regards the traditional limitation of the territorial sea to three miles.
3. International *law* does not justify an extension of the territorial sea beyond twelve miles.

On these three things the Commission was unanimous. But on what was the proper limits of the territorial sea *between three and twelve miles* the Commission could not decide. As a matter of fact the Commission doubted that it would ever be able to make that decision in a way which would be agreeable to a majority of the members of the General Assembly of the United Nations. It thought that probably a diplomatic conference on the subject would, in the end, be necessary. But in the meantime the Commission, by a narrow majority, adopted the following statement:

"The Commission, without taking any decision as to the breadth of the territorial sea within that limit, (twelve miles), considers that international law does not require States to recognize a breadth beyond three miles."

By adopting this statement the Commission sought to preserve the *status quo,* although somewhat uncertain as to just what the *status quo* was at the present time.

While these international meetings, under the auspices of the United Nations, were taking place, the United States was carrying on a colloquy with Ecuador, Chile, and Peru in another arena. Ecuador this spring had seized a northern

California and a Washington vessel well beyond three miles from her coast and in the course of the seizure an American fisherman was seriously wounded. The Congress took a deep and quick interest in the matter. The upshot of the controversy was that the United States asked Ecuador to take the case to the International Court of Justice, enter into a conservation treaty with the United States which would safeguard the productivity of the tuna resources in the Eastern Pacific against over fishing, and in the meantime stop seizing boats until the case was adjudicated. It told Chile and Peru that it would be pleased to have them join in the case—since all three have identical two hundred mile claims.

The three countries refused to take the case to the World Court. They do not have to take the compulsory jurisdiction of that court unless they want to. But their refusal to do so puts them in a bad light internationally, because it looks as if they thought they would lose.

They did agree, however, to negotiate with the United States toward a conservation treaty which would prevent overfishing in the Eastern Pacific quite apart from these juridical matters. To this end the United States, Chile, Ecuador, and Peru began negotiations in Santiago, Chile, on September 14 of this year. The delegations met steadily for a little more than a month. There was good will on both sides and a sincere effort was made by all of the delegations to find a common meeting ground upon which they could agree. But this turned out to be quite impossible at the present time.

The reason for this was the conflict in claims over the width of the territorial sea. At the outset it was decided that the conference would conduct its deliberations quite apart from this conflict and concern itself with conservation instead and solely. But this was easier to say than to do. The conflict of claim arose at every point and could not be put aside. At last the conferees came down to this point: If a conservation commission was established under treaty among the four countries, and if it adopted conservation regulations, and a foreign flag vessel were seized off the coast of one of these countries, in whose court should the defendant be tried?

If the United States agreed under treaty that its citizens could be tried in a foreign court for an offense committed twenty miles from shore it would be admitting that that area was not high seas, for an American citizen has a constitutional right to trial in American court unless within the jurisdiction of a foreign sovereign. If, on the other hand, the other countries agreed that such an offender could be tried in any other court than that of the country off whose coast he was seized, they would be admitting that the sea out to a distance of 200 miles was not, in fact, their sovereign territory.

On this note the negotiations were adjourned, but in a friendly spirit. It was not that anyone was mad or was going to start seizing boats right away. It was only that the countries would not agree on the breadth of territorial sea, and until they did their delegations could not frame an adequate and mutually satisfactory conservation agreement.

A contributing factor was that there was, actually, no international conservation problem in the area. The fish stocks which are exploited by more than one country in the whole Southeast Pacific are bonito, anchovy and tuna. There is general consensus that the bonito and anchovy fisheries of the area are underdeveloped—not overfished. They are not fished by Americans except for a miniscule amount of anchovy caught for bait.

With respect to tuna the United States, Costa Rica and Panama are joined

under treaty in forming the Inter-American Tropical Tuna Commission which since 1950 has been studying the tuna fishery of the whole eastern tropical Pacific from California to Central Peru. It is now in a position to make adequately substantiated statements about the state of the resources. With respect to tuna bait it has affirmed that no over fishing is taking place on any species being fished. With respect to skipjack tuna it has shown that the resource is underfished. With respect to yellowfin tuna the Commission feels that the fishery in 1951 had probably reached the maximum productivity that could be had from the area on a sustainable basis. But for the past four years the intensity of fishing for yellowfin had been decreasing steadily because of economic causes and no overfishing could be anticipated without a sharp reversal of the economic trend, which was not in immediate prospect.

The meetings held this year, and referred to above, have been important. There will be held during the coming year four additional meetings of equal, or perhaps even greater, importance: (1) The Inter-American Council of Jurists at Mexico City, (2) The specialized conference on the conservation of Marine Resources to held under the auspices of the Organization of American States in Ciudad Trujillo, (3) The eighth session of the International Law Commission to be held in Geneva, and (4) The eleventh session of the General Assembly of the United Nations to be held in New York.

It is not likely that full agreement among nations will be reached on these subjects even at the end of this coming year's series of meetings. But there are these straws in the wind that the participants in high seas commercial fisheries of the world can profitably take heed of:

1. They had better get an adequate program of scientific research going in their fishery so that when someone challenges them on overfishing they can either prove to an unbiased court or arbitral board that they are not over fishing the resource in question, or that the regulations under which they are fishing are adequate and appropriate to prevent overfishing.
2. If they fish off the coast of other countries and the coastal villages need the product of their coastal resources for their sustenance, the foreign fisherman had better be prepared to give way before that humanitarian plea.
3. If a group of fishermen are fully utilizing a resource and are keeping it at a stage of maximum sustainable productivity by curtailing their effort under conservation regulation, then the new fisherman coming from another shore had better be prepared to go elsewhere for his fishing because the careful husbanders of the resource will in the end win their plea before the sounding board of world public opinion too.

With these limitations, however, it looks as if the fisheries of the sea will be permitted to develop with a minimum amount of political interference.

Resolving Controversy Between Sport and Commercial Fishermen

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Abstract

Ignorance is clearly the basis of the disputes that often arise concerning

the exploitation of our saltwater fisheries. Seldom, if ever, do we know whether the claims of the opposing parties are justified. The two groups are widely removed at the social, economic, educational, and philosophical level, and these differences are aggravated by emotional factors, often influenced by irresponsible journalists.

In Virginia, such controversy does not often reach serious proportions. Several reasons may be cited: a generally thoughtful and tolerant attitude on the part of the leading sportswriters, a feeling by the leading sport fishermen's organizations that the seafood supply is sufficient for all, and a personal interest by many commercial seafood operators in recreational fishing.

The ultimate solution to such controversy is facts. Pending the accumulation of knowledge, however, there is a pressing need for education, to convince the public that argument is futile unless supported by facts, that commercial and sport fishermen must cooperate with each other, and with biologists and legislators, if the facts are to be secured, and that opinions are not synonymous with reason. The conservation agency must take the lead in promoting goodwill and understanding.

Conservation of an East Coast Shad Fishery

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Most fishery administrators and biologists would agree that *Conservation* relating to fishes means to them something like "wise utilization of fishery resources." This, of course, implies some sort of management of the fishery. How this is to be accomplished, or indeed, even if it can be, does not seem to be so readily agreed upon.

Usually a fishery is depleted before critical management procedures are considered, and corrective measures then call for restriction of the catch, at least during the initial stages of recovery. Huntsman (1953), however, has stated, "There seems to be no good basis for restricting fishing in order to increase the long term yield." Taylor (1951) has also pointed out that although "particular species have fluctuated in abundance, the yield of the sea fisheries as a whole or of any considerable region has not only been sustained, but has generally increased . . ." Others have argued (Burkenroad, 1951) that natural fluctuations in abundance may be the cause of the declines in some fisheries and that little can be done in controlling them.

On the other hand, where serious attempts have been made to understand the dynamics of a fish population and then to manage the fishery on scientific principles, the results have been most encouraging. Outstanding examples on our west coast are the work on Pacific halibut which has been notably successful, and on Fraser River sockeye, which has been a spectacular success.

In 1950 the Atlantic States Marine Fisheries Commission sponsored legislation to provide funds to the Fish and Wildlife Service for a coast-wide study of the shad *(Alosa sapidissima)* in order to provide basic information for state shad fishery regulations along the Atlantic Coast. As part of that study the Service began its work with investigation of the Hudson River shad. Emphasis

was placed on defining the dynamics of the fishery to the extent that the possibility of managing the fishery could be explored. The Hudson fishery was of particular interest, since, contrary to the general downward trend of the Atlantic shad fishery since the beginning of the century, the catch had increased between 1936 and 1946 to almost its former level of production, and then declined to a low level by 1950. The objectives of the study were to discover the factors causing the decline, to determine conditions favoring recovery, and to provide information for proper management of the fishery. This study has been completed (Talbot, 1954) and the fishery is now being managed with excellent results.

When work was begun on the Hudson River it was realized that the catch made each year by the fishermen was not necessarily a good index of the size of run since the size of the catch depends not only upon the size of run, but also upon the number of nets being fished. To establish the relationship between the catch and size of run (fishing rate) a tagging program was carried out.

In 1951, 524 shad were caught, tagged and released at the mouth of the Hudson while the shad run was in progress. These mixed with the untagged shad and continued upstream with them. They were first intercepted by the New Jersey fishermen who fish near the mouth of the river and then by the New York fishermen who fish farther upstream above the state boundary. These fishermen were contacted regularly and their total catches were recorded along with the number of tags they recovered. A total of 755,000 pounds of shad were caught along with 46 per cent of the tagged fish. Since 46 per cent of the tagged fish were caught, we could infer that 46 per cent of the shad in the river were caught and, therefore, by simple proportions the total run entering the river was calculated to be 1,641,000 pounds of shad.

A total of 1,641,000 pounds was, therefore, available to the New Jersey fishermen and, according to our records, they had caught 332,000 pounds. There was then 1,641,000 pounds minus the 332,000 pounds caught, or 1,309,000 pounds available to the New York fishermen. Of this amount the New York fishermen caught 423,000 pounds, leaving 886,000 pounds of shad to spawn.

Statistics showing the catch of shad in the Hudson River by New York and New Jersey fishermen, and also the number of nets used each year, were available for each year since 1915. The New Jersey gear appeared to be much more efficient than the New York gear—probably because the river is narrower than in the New York section. It was, therefore, necessary to determine the fishing power of the gear of each state so that they could be combined to determine the total fishing effort for each year. To do this the following calculations were used: We let p equal the fishing power of a single unit of gear, and defined "fishing power" to mean the ability of one unit of gear to capture a certain fraction of the fish present in the river in one day's fishing. We let q equal the fraction of the fish that were not captured so that $p + q = 1$. Now, if we consider the run as a whole and denote its size by N, the number of pounds of shad removed in one net-day of fishing would equal pN, and the number remaining would equal qN. The fish not caught by the first net-day of fishing are susceptible of being captured by the second net-day of fishing during which pqN are removed. The number of pounds removed and the number of pounds remaining after successive net-days of fishing would then be as follows:

	No. of pounds removed	No. of pounds remaining
1st net-day	pN	qN
2nd net-day	pqN	q^2N
3rd net-day	pq^2N	q^3N
4th net-day	pq^3N	q^4N
*	*	*
*	*	*
*	*	*
n-1 net-day	$pq^{n-2}N$	$q^{n-1}N$
nth net-day	$pq^{n-1}N$	q^nN

After the nth net-day of fishing there remains q^nN pounds of shad in the river. In this case n equals the fishing effort, or in other words, the number of nets fished multiplied by the number of days they fished which was available; and N, the total run, and the number of pounds of fish remaining (spawning escapement) were determined from the tagging program. The only unknown, therefore, is q which can be calculated for the gear fishing in each state. From the calculated q's, the p's were determined easily, since $p = 1\text{-}q$. We then had a measure of the fishing power for the gear of each state and found that the New Jersey gill-nets had about five times the fishing power of the New York nets. A New York net was taken as the standard unit of fishing effort and the total net-days fished each year between 1915 and 1951 by the New York fishermen were combined with net-days fished each year by the New Jersey fishermen, increased five-fold. This gave us the total fishing effort exerted by the shad fishermen of the Hudson River for each year since 1915 in standard fishing unit days.

Now, as previously shown, pN is the number of pounds of shad removed the first standard fishing unit day, pqN is the number of pounds removed the second fishing unit day, and so forth. It can be seen that in any season the total catch is as follows:

$$C = pN + pqN + pq^2N + pq^3N + \ldots\ldots\ldots + pq^{n-1}N$$

Factoring,

$$C = pN\,(1 + q + q^2 + q^3 + \ldots\ldots + q^{n-1})$$

Since the expression in the parenthesis is a geometric progression, its sum can be expressed by the formula $\frac{1-q^n}{1-q}$

Substituting, we have:

$$C = pN\,\frac{(1-q^n)}{(1-q)}$$ and transposing

$$N = \frac{C}{p\frac{(1-q^n)}{(1-q)}}$$ or, since $p = 1\text{-}q$, $N = \frac{C}{1-q^n}$

Since we knew the total catch (C) made in the river each year since 1915, and had the total fishing effort, n, for each year and also had the value, q, it was now possible to calculate the total run of shad, N, for each year since 1915. Since we also had the catch for each year we could, by subtraction, find the amount of shad escaping the fishery and spawning each year. With this information it was possible to compare fluctuations in size of run with factors suspected of influencing the size of run. It was not possible to do

this with only the catches of shad made each year because they are influenced by the amount of gear used in catching the fish.

Many factors were suggested by persons connected with the Hudson shad fishery as being responsible for the recent decline. These were: changes in stream flow, changes in water temperature, dredging to improve the ship channel, increase in ship traffic, curtailment of hatchery operations, pollution, natural cycles of abundance and scarcity, catches made outside the river, and overfishing. All these things were considered during our investigations.

However, before we could determine cause and effect relationship with any of these factors, additional information was needed concerning the biology of the shad. We knew that the adults return to the river of their origin in the spring of the year for the purpose of spawning, and it is at this time that the commercial fishery takes the harvest. Those that escape the fishery and do not die from natural causes, spawn and return to the ocean, and if they do not die of natural causes or are not caught elsewhere, they come back again the following spring to spawn. The eggs of the shad hatch in five or six days, and the young live in the river until the fall when, at a length of three or four inches, they leave for the ocean. It was vitally necessary, however, to know at what age these fish return as adults to spawn for the first time, since any factor adversely affecting the young, for instance, would not become evident in the fishery until the time they would normally return as adults.

To determine this, scales from a sample of shad were taken throughout the runs of 1950 and 1951 from the catches made by the fishermen. A method was found to read these for total age as well as for the number of times they had previously spawned. It was found that the majority of shad returned to the river as adults for the first time at four and five years of age. Therefore, it could be expected that any factor affecting the young of any one year would not show until four and five years later. It was also found from the scale readings that about 50 per cent of those captured had spawned in previous years.

With the age-composition of the shad known, it was possible to make valid comparisons between factors suspected of affecting the run and the size of run each year.

No effects from variations in stream flow or water temperatures could be found. Dredging in the river had no measurable effect on size of shad run, but deepening the river increased the number of ships running up the river to Albany. Shipping appeared to have no effect on the size of shad run, but did increase the hazards of fishing and caused loss of fishing gear and damage to boats.

Production of shad hatcheries had no measurable effect on subsequent size of the shad runs and no evidence of natural cycles of abundance was found. Evidence of gross pollution of the river was found, but this condition has apparently been serious since the beginning of the century. Pollution abatement probably would increase the productivity of the river and certainly would result in a higher quality fish, but there was not enough evidence available to compare fluctuations in the size of run with changes in pollution. Catches outside the river undoubtedly influenced the run, but there was no way to distinguish the Hudson River fish from the other shad caught outside the river and so this effect could not be determined.

In analyzing the effect of fishing on the size of the run, or in other words, to determine if overfishing caused the recent decline, a comparison was

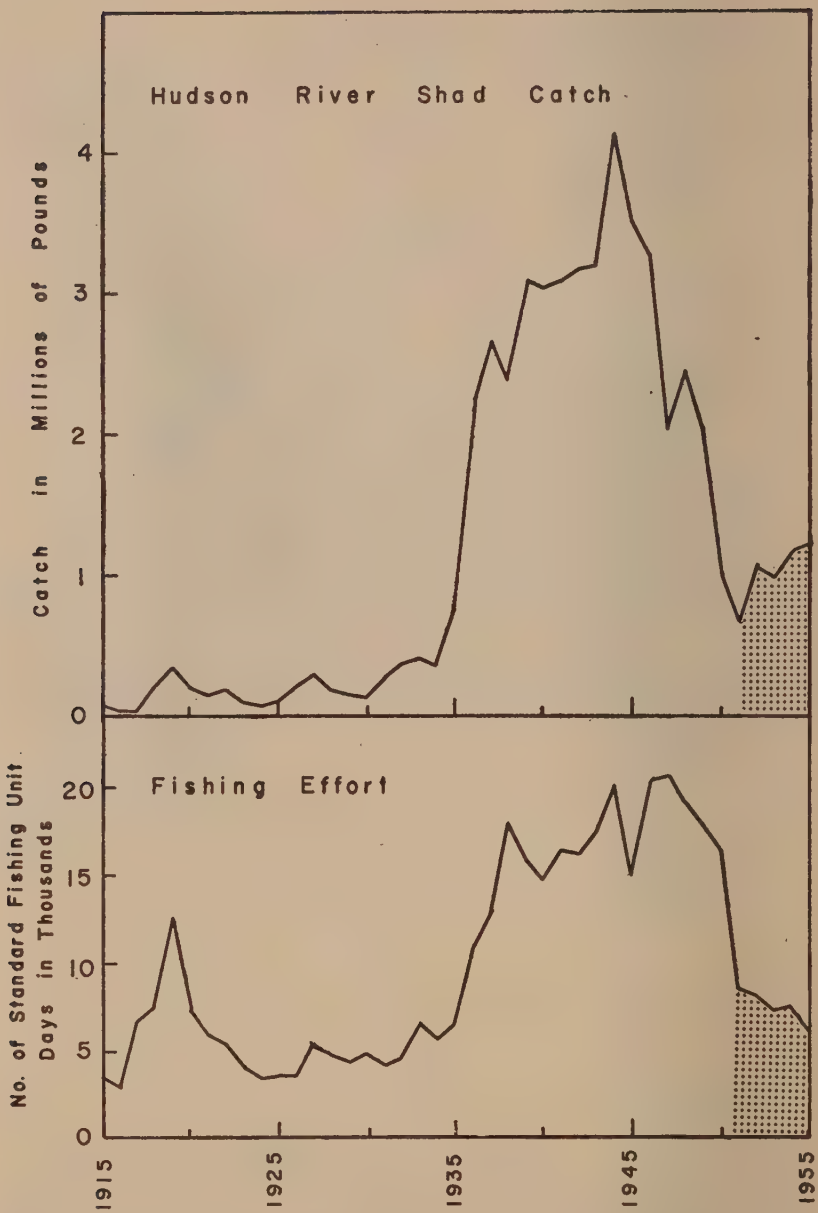

FIGURE 1.—Hudson River shad catches and fishing effort from 1951 through 1955. Data to 1951 from Talbot (1954). Data after 1951 from New York and New Jersey statistics.

made between the size of run in any year and the size of the spawning escapement the year previous and four and five years previous. This was done because it had been shown from the scale readings that about 50 per cent of the catch

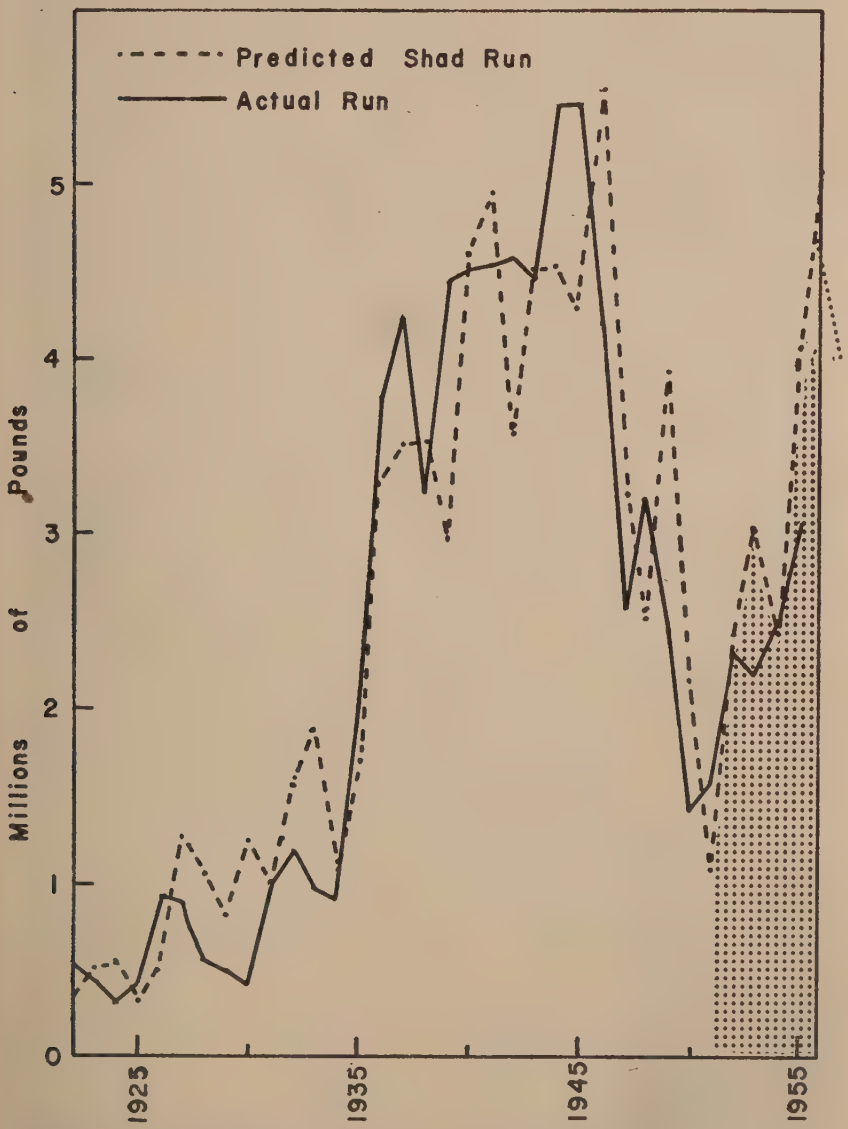

FIGURE 2.—Predicted and calculated actual shad runs, in pounds for Hudson River, 1922 through 1956.

was made up of shad which has escaped the fishery the year previous, and that the majority of the fish caught were four and five years old. Those allowed to escape the fishery and spawn would return the next year in the fishery and their progeny would return and enter the fishery mostly four and five years later. This comparison was made using a mathematical analysis termed a multiple regression analysis. This disclosed that there was a very significant correlation between the amount of shad allowed to spawn each year and subsequent shad runs. In fact, 85 per cent of the fluctuations in size of run could be accounted for by changes in the escapement. Since the size of run is determined by the amount of fish allowed to spawn, it was possible to predict by the use of an equation, using the calculated escapements what the total run should be one year in advance. This was done for each year for which statistics were available and the predicted populations agreed closely with the actual calculated populations. It could be seen from these comparisons that the amount of fish allowed to escape the fishery each year was responsible not only for the recent decline, but also for the great increase in size of run between 1936 and 1946. The equation, plus the statistics of the catch and effort, were the tools needed to regulate the fishery to produce maximum yields each year. Since the size of run could be predicted one year in advance, fishery regulations could be formulated to allow a predetermined escapement which would give the desired size of run four and five years later.

In 1951 it was realized that the fishing intensity was too great for the size of shad runs, and concurrent restrictive regulations of the fishery were imposed by both New York and New Jersey as a means of conserving the fishery. The fishing intensity was decreased to about one half that which had been in effect for the past several years and in 1951 only 755,000 pounds were caught. The small sacrifice in catch, however, has paid off. The lower catch resulted in an increased spawning escapement that year and the following year the shad run began to increase because of the increased "repeaters" from the year before. The fishing effort has continued to decline, but in spite of less fishing being done, the total catch of shad has increased from 755,000 pounds in 1951 to over 1,200,000 pounds in 1955 (Fig. 1), and in 1955 the total run was over 3 million pounds as compared to half that amount in 1950 and 1951 (Fig. 2). As a result of the facts developed by the intensive study of the Hudson River shad and the prompt action of the States of New York and New Jersey in amending their regulations, this fishery is now well on its way toward being restored to its former level of abundance.

The results of this study appear to add weight to the theory that at least some of our fishery resources can be scientifically managed so as to produce maximum sustained yields year after year. In many cases the problems involved in doing this are not great. The most important tools necessary are adequate catch and effort statistics compiled over a series of years. These, in combination with a comprehensive research program, can point the way to sound conservation programs.

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Principles of Shrimp Fishery Management

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Introduction

THERE ARE TWELVE OR MORE SPECIES of shrimp of the family Penaeidae living in the waters of the Gulf of Mexico at depths of forty fathoms or less. The flesh of all of these is edible, but small size and rarity exclude the majority from the commercial catch. Possibly the tastiest shrimp in this area are two species of the genus *Sicyonia,* commonly known as stone shrimp because of their hard shells. They are also rather small and are not very numerous. A night's dragging may yield ten to fifty pounds. They are consumed only by the fishermen themselves and perhaps a gourmet here and there. They have been marketed sporadically and rarely at Brownsville, but we are not concerned with them here.

On the Louisiana coast the "six barbes" of the French fishermen, *Xiphopeneus kroyeri,* or sea bob of the other fishermen is sometimes used on the drying platforms. It is also a very delectable shrimp, but it is just barely large enough to eat, at least for the American taste which is now well accustomed to larger shrimp. Production may be a million pounds a year or even less and in the following remarks we shall not be concerned with them either.

The 200,000,000 pound annual shrimp production of the Gulf of Mexico is based on three species of shrimp. Ranked in order of catch, the first is the brown shrimp, *Penaeus aztecus* Ives, followed by the white shrimp, *Penaeus setiferus* (Linnaeus), and last is the pink shrimp, *Penaeus duorarum* Burkenroad. Roughly, each succeeding shrimp in this short series yields about half as much as the preceding one.

The brown shrimp production is greatest in the western Gulf, especially along the lower half of the Texas coast and Mexico as far south as Obregon, at the very southernmost part of the Gulf of Campeche. Thus, part of brown shrimp grounds lie south of the Campeche pink shrimp area, a fact not commonly appreciated. There is also a small ground for white shrimp lying closer inshore, and farther south, in the same area. It should be noted, however, that the brown shrimp is also becoming increasingly important east of the Mississippi, at least into Alabama waters.

*The writer is indebted for support of certain work in connection with this project to Chief William Red Fox, of the Ogallala Sioux.

The major production of white shrimp has always been in the State of Louisiana where the mighty Mississippi fathers the largest estuarine area on this continent. This was "the shrimp" of the commercial fishery until the Texas fishermen began to produce brown shrimp in 1947 and 1948. The pink shrimp fishery of the Tortugas area began in 1949 and an account has been given by Idyll (1950). The pink shrimp grounds of the Campeche banks were discovered in 1936-37 by the Japanese, who kept quiet about it. They were rediscovered by a Texas fisherman in 1947 and developed by Texas operators in 1950. Very shortly thereafter the Florida fishermen came into the picture.

To summarize briefly, the pink shrimp are caught in two discrete areas in the southern Gulf. The brown shrimp are caught in the northern and western Gulf all the way down to Yucatan. The white shrimp are caught mostly around the mouth of the Mississippi River, with production diminishing east and west, with the limits roughly at Brownsville, Texas and Apalachicola, Florida, also a small pocket at the southern tip of the Gulf next to Yucatan.

These shrimping areas are not continuous as some recent publications and maps would have us believe. They are in fact quite discontinuous, partly because of untrawlable bottom and probably for other reasons that are not understood.

Biological Factors Related to Management

There are some peculiar resemblances and differences between these three species of shrimp. The white shrimp is differentiated from the other two species by the fact that there are no grooves along the sides of the dorsal spine. Furthermore, the spermatophores are placed or stuck at the base of the fifth walking legs and there is no receptacle for them. The most closely related species seems to be *Penaeus schmitti* Burkenroad of more southerly waters, which is not fished in the Gulf. In contrast the females of the two grooved shrimp have a small pouch, called the thelycum, for reception of the spermatophore. The ecological relationships of the species do not follow the anatomical patterns.

The adults of these three shrimp also have different depth ranges. About 43 fathoms seems to be the outer limit of the white shrimp, but few are found deeper than 20 fathoms, and most of the catch is taken at 14 fathoms and less. The majority of brown shrimp are caught between 18 and 25 fathoms, but there is a thin population of larger animals extending out to 45 fathoms and possibly beyond. Springer and Bullis (1954) found pink shrimp at depths of 37 fathoms but it is rare at greater depths than 28 fathoms, and most of the commercial catch on the Campeche banks is taken between 20 and 28 fathoms.

The white and brown shrimp are found on mud bottoms. The pink shrimp is found on calcareous sand and to a lesser extent on quartz sand with some mixture of mollusk shells. The young of the white and brown shrimp both invade low salinity estuarine waters and it would appear the white shrimp must invade such areas to grow up for they are found nowhere else under natural conditions. However, some experiments carried on by Mr. Malcolm Johnson indicated that small white shrimp grew well at high salinities and did better than another group at medium salinities. Whether or not it is necessary for the shrimp to have the low estuarine waters for growth of the younger post-larval stages, the bays are utilized as rearing grounds by both species.

The salinity limits are only slightly lower for the white shrimp than for the browns, but the former are considerably the more abundant in the fresher waters. These salinities approach one part per thousand. (For weeks on end I have drunk common tap water of the City of Port Aransas, Texas, which ran 4.9 parts per thousand salt.) In contrast, the young pink shrimp do not often invade low salinity waters, although they have been found by Tulane zoologists at low salinities in Lake Pontchartrain. In fact they avoid such areas, and grow up in shallow, high salinity areas such as Florida Bay, so-called, which is really not a bay but only an area of flats and shallows bordering the open sea. In spite of the fact that young pink shrimp have been found recently in the high salinity bays of the south Texas coast during the recent drouth, the only common feature of the nursery grounds of the three species is the fact that they are all shallow waters. However, they have this in common with the commercial river shrimp of the Mississippi Valley (Gunter, 1937) and, in fact, the young of most marine animals are found in shallower waters than the adults. The point of interest here from the management standpoint is that these growing shrimp can be fished by the little cracker-box boats which cannot compete in the offshore shrimp fishery.

The size ranges of the white shrimp run about 18-20 to a pound. Larger pink shrimp run 15-18 to a pound. The common commercial brown shrimp run about the same size, but at depths of 40-45 fathoms they run 4-6 to a pound. The very largest whites also occasionally run 6 to a pound.

Management and the Prospects of Management

Due to a natural predilection of the human race and to the evident wisdom of protecting the young in certain instances where animals have restricted spawning areas, chiefly in fresh water, we often look first at these matters. We know that shrimp spawn at sea and that their minute larvae drift about in the water, passing through some twelve to fourteen stages which look like quite different organisms. We have an outline of this stage of the life cycle of the white shrimp due to the work of Pearson (1939) and Heegaard (1953), but there are several questionable points. There is less known of the brown shrimp. Pearson says the larvae of this species come in at all times of the year, but the writer has shown (Gunter, 1950) that the post-larval young do not appear in the bays at all times of the year. Furthermore, the life history of this species seems to be just as seasonal and cyclic as any other species. Of the pink shrimp larvae we know nothing except what may be inferred from work on the others. We do know, however, that the larval history and stages are much the same for all the Penaeidae. Madame Heldt in Morocco and Doctor Hudinaga in Japan preceded recent American workers and together these works demonstrated the similarity of all species. This fact creates great difficulty in following the stages of one species in such areas as the Gulf, where twelve species exist in the shallow waters, and their larvae may also be confused with several more that live in deeper water.

Be that as it may, larval shrimp do somehow drift comparatively long distances into shore in quite large numbers. This is an amazing thing, and all we know about it is that it happens. The ripe females spawn offshore and a few weeks later the advanced larvae appear inshore, where they settle to the bottom, acquire color, and from then on live as shrimp.

With management in mind, we may ask what can we do about the larval shrimp? In the first place we do not know what to do and it is difficult

to conceive anything within the realm of the remotely possible which we could do about them, if we were going to set out to try. We could determine for purposes of prediction, if there is ever a crop failure, so to speak, of incoming young, but we have no evidence that such a thing has ever occurred. Nevertheless, the point is worth investigating.

The shrimp grow up in the bays or the shallows and then move out to sea. There is where they are fished by the large shrimp boats. The life cycle of the white shrimp is short. A good many live slightly more than a year, but those living to two years are certainly a small percentage of the total, negligible both to the fishery and for management as well. Some years ago Burkenroad (1934, 1939) suggested that there may be an offshore reserve in deeper unexplored waters, but exploration is now complete and no offshore reserve has been found. In fact, the white shrimp is a relatively inshore animal found at the depths stated above. There does seem to be an offshore population of brown shrimp of very large size at depths of 30-45 fathoms and possibly beyond, which is not fished because it is too thinly scattered. They will always serve as a breeding stock even if the inshore population were wiped out. In fact, the white shrimp population does seem to be wiped out every year, or almost completely so, before the next generation is more than well started. In this the life history is similar to that of the Pacific salmon, except the salmon lives four or five years—and there is always a group at sea which will come in to spawn next year. But the white shrimp are a one year stock, to all intents and purposes. Most of the adults are gone by the end of August every year. They may die after spawning, but it is more likely that after spawning they are in a weakened, debilitated condition and then fall prey to the innumerable predators which assail them from every side at all times. A few may survive this critical period by chance and thus live into the second year. It is a general observation of everyone working with shrimp that they are eaten by almost everything that is large enough to eat them, all the time. They are eaten by everything that lives around, in, or above the sea, including the lowly jellyfish. They are not only eaten but they are preferred. Many fishes prefer them, as the author has shown (Gunter, 1945) and it was noted long ago (Gunter, 1941) that when shrimp were washed ashore by hard cold waves the gulls seized them first and only turned to fish when no more shrimp remained.

Larval shrimp fall prey to plankton feeders, but they are protected from larger predators by small size and their colorless condition. In the shallow, lower salinity waters the numbers of species of animals are less than in the open sea, simply because many marine animals cannot withstand lowered salinities. Thus the numbers of predators are less in the shallows, but when the shrimp venture out into the open sea they are faced by a veritable array of fanged and clawed goblins of the deep, and as a matter of fact they do not survive long. Shrimp are not very intelligent animals and it is a good thing, for otherwise they would all soon be scared to death and thus cease to exist. This brings to mind the remarks of Wm. J. Long, who said that God had given the dumb animals two great blessings, no regrets for the past and no fears for the future. Burkenroad has suggested that probably the fishermen get less than half of the shrimp and that is quite likely true.

The picture presented here is quite likely the true situation. What then should be done regarding shrimp in the open sea? There seems to be nothing to do but catch them as fast as possible before something else catches them

first. You might ask, catch them all? What about the breeding stock? The answer is: You cannot catch them all, and probably not even a major part of them, and there is always enough breeding stock. In 1940 an extremely hard cold wave struck this country. It killed out practically all the shrimp on the South Atlantic Coast. The Shrimp Investigations personnel of the Fish and Wildlife Service was in the area at the time. They could not find a hatful of shrimp and immediately put out a mimeographed circular exhorting the fishermen not to catch any more shrimp. The fishermen got worried and no one wanted to be low man on the totem pole, so they got out and fished as hard as possible, only to verify the Service's findings. They came home and laid up their boats so long that sparrows built nests in the rigging. There was no spring shrimp fishery, but during the fall the shrimp crop came back as abundantly as ever. The few shrimp remaining after this catastrophe were evidently enough to repopulate the area. This episode afforded me the opportunity to twit my colleagues and I did so, but it is by such happenings that we learn.

The next example comes from an unpublished observation of Mr. Percy A. Viosca, Jr., who often arrives at the right conclusion by uncommon, if not unorthodox, means. Sprague (1950) has described a microsparidian parasite which attacks the gonads of shrimp and in effect castrates them. Mr. Viosca states that one year this disease seemingly castrated 99 per cent of the shrimp in Louisiana waters, but next year the crop was as good as ever.

A little figuring will give some indication of the probable reason for this situation. Five million pounds of shrimp of large size make up 100,000,000 individuals. If each female spawns 500,000 eggs, this will give fifty trillion eggs.

So the indications are that there is nothing to be done about the larval shrimp nor is there anything to be done about the adults in the open sea, except to catch them. Then what about the growing young in the bays and shallows? That may be a different situation. We do not know enough facts about the matter, but here are a few ideas upon which some speculations may be based.

We may look at the problem this way: The young shrimp come into the bays and grow up and then return to the sea. If you have a million pounds of 60 count shrimp in a bay, will you have the same money value of shrimp if you wait until they are 30 count shrimp before catching them, or, will the shrimp die so fast that you would have less in money value? That is the question facing the fishermen. Actually, it devolves upon two questions. How fast do the shrimp grow and how fast do they die? We only have information on the first question, which so to speak, leaves us only one leg to stand on. However, we may be able to set some limits for the other.

Viosca (see Tulian 1919) first recognized that the shrimp have a very fast growth rate, for he said they grow up "in six months or less." This would mean that they increase in length at the rate of about 1 mm (one twenty-fifth of an inch) a day. I found that only such a fast growth rate would fit the other facts of the shrimp life history and independently proposed it (Gunter, 1950) over thirty years later. However, it may not be as independent as it appears for I got the idea from M. D. Burkenroad, as was stated, and although he was honest about it, Burkenroad may have well picked up the idea from Viosca with whom he was associated some twenty-five years ago. Recently Williams (1955) has stated that young white shrimp in North Carolina grow at the rate of about 1.5 mm a day, brown shrimp

at nearly 2. mm and young pinks at 2.3 mm. This may well be the case for young shrimp.

Be that as it may, a shrimp which doubles its length increases its weight by about seven times. We do not know the precise figure. If we have a shrimp 50 mm (2 in.) long, in about 50 days it will be about seven times as large by weight, taking the slower growth rate suggested. Thus it would double its weight in a week. Thus even with a fifty per cent mortality of the population every week, the total weight of the shrimp population would be maintained. At this maintained rate of mortality, practically all shrimp would be gone in nine weeks. An average mortality of fifty per cent each month would reduce the population to almost nothing in a year's time and that is more likely. If the average growth rate were maintained, up until the last month or so, then the weight of the population would be increasing all the time up until the last few months.

Actually the mortality is not held on an average. It is probably very high at first, say about 75 to 90 per cent per month and falls rapidly as the shrimp grow, being lowest before they pass out of the bays. In the Gulf it probably increases again, until the onset of cooler weather and rises again in the spring, this holding, of course, only for the northern Gulf.

In any case, if we go back to the example above of 50 per cent mortality a week, which is about 94 per cent mortality a month, the weight of the population will be maintained.

But let us take value alone. Sixty count shrimp are on the bare edge of being marketable. The chances are that 30 count shrimp are worth twice as much to the fishermen or more. Thus we would only have to catch 500,000 pounds of an original million to make as much money. Thus, if our figures and assumptions are anywhere near correct, fishermen could wait one week when the weight per shrimp would have doubled and make just as much money, if 75 per cent of the shrimp had died. At this rate of mortality, 99.6 per cent of the shrimp would be gone in a month. It is highly unlikely that shrimp in the bays die so fast.

This can be shown in a number of ways. If the total spawning stock of female shrimp in the Gulf of Mexico were 25,000,000 pounds it would be approximately a half billion shrimp. Anderson, King and Lindner (1949) say that shrimp spawn 500,000 to 1,000,000 eggs at a time. Not all of these would hatch, but since we now know that some shrimp at least spawn more than once a season, let us take the larger figure and assume that all eggs hatch. This would yield 500 trillion larvae; but at an average mortality rate of 75 per cent a week, or 99.6 per cent a month, in three months time there would be only 32,000,000 shrimp left, or considerably less than the number of parents. But this is unreasonable, for by and large the shrimp stocks maintain themselves. Such a mortality rate would not permit maintenance of the stock, let alone support a shrimp fishery. Yet with such a mortality the shrimp fishermen taking small shrimp in the summer, would not lose money if they waited a week and caught half as many shrimp.

But let us take another example. What would be the case if the mortality were 50 per cent a week and the bay population of growing shrimp only maintained its weight? This is a mortality rate of 92.75 per cent a month. Starting again with the 500,000,000 spawning shrimp and the 500 trillion larvae, we find that in three months time there would still be less shrimp than the original spawning stock. Thus, such a mortality still seems to be unreason-

ably high. In fact, if the figures about reproductive rates are near correct at all, it takes an average mortality of around 60 per cent per month to reduce the number of young to the original spawning stock in 12 months. This would be about a 40 per cent mortality per week. Since, as we have seen, the mortality of eggs, larvae, and older shrimp in the Gulf are probably higher than growing shrimp in the bays, then it seems that the average weekly mortality of bay shrimp may be even less than 40 per cent. Using this figure we find that a million pounds of shrimp would become two million in a week, during which time the death rate would leave 1,200,000 pounds of better grade shrimp.

In any case it is clear that it takes a terrifically high mortality to offset the fast growth rate of the shrimp. Burkenroad had something like this in mind when he said that all evidence we have shows that less shrimp may be present on the beds at any given time than the total annual production.

The growth rate assumed here is low, probably, for the medium sized or small shrimp and the other assumptions are conservative. Nevertheless, it seems clear that under almost any reasonably valid assumption that can be made, the fast growth rate of bay shrimp more than compensates for mortality. Therefore, it is best to wait on the small shrimp in the bays and not catch them until far into the fall. The bays should be completely closed to shrimping in July, August and September, if not at all times.

The above situation is the only management policy, I can see, that we can apply or need to apply at present. It cannot hurt any one very much. Now you might say that I have labored mightily and brought forth a mouse, but I have tried to show where we stand and in a way it is good that we have to do so little. In any case the proposed inductive approach suggested by Burkenroad (1951), of opening and closing bays on alternate years, with a determination of results, is an unwieldy affair and seems to be obviated by the above suggestions.

But there is one more factor we should hold in mind. The bay and shallow water environment must be preserved at all costs. That is the vulnerable point in the shrimp life history. If the shrimp ages ago adapted themselves to rearing their young in the estuarine waters and shallows, so as to escape the multitudinous goblins of the deep, it will be a bitter cosmic joke for them to run into a worse one who destroys their rearing grounds, now that they have nowhere else to go.

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International Law and the Fisheries

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THE EXPLOITATION OF FISHES in the high seas—the backbone of the world's commercial fishing industries—has become a matter of serious international concern, commanding the attention of the General Assembly of the United Nations.

This was the subject of study at the United Nations International Technical Conference on the Conservation of the Living Resources of the Sea, held at Rome, April 18th to May 10th, 1955.

The 1955 Rome Fisheries Conference had its genesis long before the General Assembly resolution which convoked it. It was made necessary by four things. The first of these is man. From the time man began fishing many eons ago, we have had the rudiments of a fishery conservation problem. It was only a question of time until the forces of nature pitted man's hunger against the capacity of the fish populations to satisfy it. That time has come with respect to a number of species of fish. Last year alone the world's population of over two

and one half billion was increased by 35,000,000 souls. These must be fed and much of that food will be fish.

The second circumstance contributing to the Rome Fisheries Conference is the doctrine of the freedom of the high seas. That doctrine, simply put, means that those vast reaches of ocean seaward of territorial waters belong, at once, to all and to none. That is to say, they are encumbered by no proprietary right, being free for enjoyment and use by vessels of all flags in their lawful pursuits. The body of law applicable to this regime is known as international law, that system of rules by which nations govern their relations with one another, and international law recognizes that freedom of fishing appertains to the high seas. This doctrine of the freedom of the high seas has a long and turbulent history, fluctuating between the extremes of claims affecting entire oceans on one hand, to sovereignty over a fixed, narrow, marginal belt on the other, such claims having been related to protection of shipping from piracy, or to providing a basis for taxation, or even to the control of fisheries. Beginning as early as the thirteenth century paramount rights in wide sea areas were being asserted by the maritime powers of that day. As long ago as the early part of the seventeenth century the Dutch and English were knocking heads together over prior rights to fish for herring off the British and Irish coasts. From that particular dispute emerged Grotius' celebrated work *mare liberum,* the foundation of the free seas principle which has promoted commercial intercourse benefiting the world as a whole.

Now, it follows that no matter how hungry a man gets and no matter how liberal his rights to take fish from the oceans, unless the fisherman is able to capture fish in quantity there still is no conservation problem. That brings us to the third factor responsible for our present problem; namely technological development and progress. Man's capacity for creating efficient fishing vessels and gear, and for devising efficient fishing methods, is of a high order, so that he can deplete some fishery resources at the expense of posterity.

Finally, we have the consideration of man's relationship with man, or to be more specific, a fisherman's relationship with a foreign fisherman. Irrespective of nationality, the fisherman's object is to get food, and from a source open equally to all.

Thus there is created a fisheries conservation problem, real or potential. This brings about the necessity of devising a scheme whereby sovereign nations might work together for a solution and this puts the remedy on the plane of cooperative international action.

The General Assembly of the United Nations realizes this, for at its Fourth Session, in 1949, it charged its committee of legal experts, known as the International Law Commission, with responsibility for study and recommendations on various aspects of international law, with a view to their eventual codification. Among these was the Regime of the High Seas, which included the topic "Resources of the Sea." By the time of the General Assembly's Eighth Session in 1953 the International Law Commission had come up with a set of recommended general principles for the protection of high seas fisheries, but in doing so admitted that much of this subject was of a technical character and, as such, was outside the competence of the Commission. The General Assembly decided to table consideration of this subject until the Commission's work was completed, at which time it would be considered as a body. Then, during its Ninth Session, in 1954, the General Assembly entertained favorably a resolution, co-sponsored by the United States and nine other countries, calling for

a conference to be convened at Rome on April 18, 1955 to be known as the International Technical Conference on the Conservation of the Living Resources of the Sea. The function of this Conference was to consider the problem of high seas fisheries conservation on a scientific, technical, and practical basis with a view to advising the International Law Commission that it might be better able to draft a set of suitable articles on the subject for consideration by the General Assembly. Meanwhile, the General Assembly had decided that the work of the International Law Commission on the Regime of the High Seas should be completed in time for General Assembly action at its Eleventh Session in the Fall of 1956. This explains why the Rome Conference was convoked only four months after its authorization by the United Nations. The United States played a leading role in getting this resolution approved, as well as at the Conference itself, because of its experience in this field involving eight conventions to which it was then a party (they now number nine), with twenty different countries.

This brings us to the Rome Conference itself. The governments of forty-five countries sent representatives, and the governments of six countries sent observers. In addition, the Food and Agriculture Organization and the United Nations Educational, Scientific and Cultural Organization, together with eleven international fishery organizations from all over the World, such as the International Pacific Halibut Commission and the Indo-Pacific Fisheries Council, had observers present. It was a representative group, and it was able to accomplish a great deal. A tremendous aid in getting the discussions and deliberations under way was the series of technical background papers prepared by an advisory committee of experts to the Secretariat of the Conference, by international fishery organizations and by fishery experts. These are listed in the appendix.

The Conference, under the Chairmanship of Klaus Sunnanaa of Norway, did its basic work through three drafting sub-committees. One dealt with the definition of the objectives of fishery conservation—a fundamental matter. Another considered the types of scientific information required for a fishery conservation program, reviewing for this purpose such topics as:

(a) Extent of separation of the fishery resource into independent or semi-independent populations, known as conservation management units;
(b) Magnitude and geographical range of the population constituting the resource;
(c) Pertinent facts respecting the life history, ecology and behaviour of the species constituting the resource;
(d) Effects of intensity and kind of exploitation on the resource; and
(e) Relationships of the resource to other species being exploited simultaneously.

This same sub-committee also gave attention to the types of conservation measures applicable in a conservation program. The third subcommittee was concerned mainly with measures that are currently being used to overcome or prevent fishery conservation problems and their applicability to similar problems and situations in other areas. The work of this latter committee afforded an opportunity to review the work, progress, and success of all the major international fishery commissions of the world, which would include those to which the United States is a party and which we regard so highly.

There were two particularly spirited moments during the Conference. The first of these derived from a definition of the objectives of conservation, in

connection with which there was a move to include in the definition: "that when formulating conservation programs, account should be taken of the special interests of the coastal State in maintaining the productivity of the resources of the high seas near to its coast." Many delegates felt this bordered on the subject of rights and therefore a legal matter outside the competence of the Conference. It was put to a vote, however, and passed by a vote of 18 in favor, 17 against, with 8 absentions. The United States Delegation supported the principle but believed it had no place in a definition of the objectives of conservation, and felt compelled to vote against it on that ground.

The second interesting moment concerned a motion to give a coastal State certain rights to take unilateral action with respect to fisheries off its coast. There was a large body of opposition to this on the "competence" grounds, and the conference decided by a vote of 21 for and 20 against that the Conference was not competent to consider it. The United States Delegation voted with the majority. The general conclusions of the Conference are contained in the following paragraphs, which are quoted verbatim.

> "Conservation is essential in the development of a rational exploitation of the living resources of the seas. Consequently, conservation measures should be applied when scientific evidence shows that fishing activity adversely affects the magnitude and composition of the resources or that such effects are likely.
>
> "The immediate aim of conservation of living marine resources is to conduct fishing activities so as to increase, or at least to maintain, the average sustainable yield of products in desirable form. At the same time, wherever possible, scientifically sound positive measures should be taken to improve the resources.
>
> "The principal objective of conservation of the living resources of the seas is to obtain the optimum sustainable yield so as to secure a maximum supply of food and other marine products. When formulating conservation programs, account should be taken of the special interests of the coastal State in maintaining the productivity of the resources of the high seas near to its coast."

This definition makes three main points:

(1) It recognizes the essentiality of fisheries conservation in the world today;

(2) It breaks down the objectives of fishery conservation into immediate objectives and principal objectives, the former being related to maintenance of at least the average sustainable yield, and the latter, the long-range objective, being concerned with maintenance of the optimum sustainable yield so as to secure a maximum supply of food and other marine products; and

(3) It recognizes that a coastal State, by virtue of being a coastal State, has a special interest in the condition of the fish stocks in the high seas near to its coast.

> "The Conference notes with satisfaction conservation measures already carried out in certain regions and for certain species at the national and international level. International cooperation in research (including statistical investigation) and regulation in the conservation of living resources of the high seas is essential. The conference considers that wherever necessary further conventions for these purposes should be negotiated."

This conclusion endorses the principle of international cooperation in re-

search and regulation for high seas fisheries conservation purposes, and the use of conventions to that end.

"The present system of international fishery regulation (conservation measures) is generally based on the geographical and biological distribution of the marine populations with which individual agreements are concerned. From the scientific and technical point of view this seems, in general, to be the best way to handle these problems. This system is based upon conventions signed by the nations concerned."

This conclusion embraces the idea that the best approach to the conservation of fishery resources is the "stocks-of-fish" approach, rather than the fixed area thesis, obviously taking account of the fact that fish are not in the habit of respecting imaginary lines drawn by States to encompass specific areas of ocean.

"From the desire expressed during this Conference by all participating nations to cooperate in research, and from the guidance given by existing conventions, it appears that there are good prospects of establishing further conservation measures where and when necessary. Having regard to these considerations and the existing principles dealt with under Section V, "Principles of International Conservation Organizations," the Conference considers that the following should be taken as the guiding principles in formulating conventions:

(a) A convention should cover either:
  (i) One or more stocks of marine animals capable of separate identification and regulation; or
  (ii) A defined area, taking into account scientific and technical factors, where, because of intermingling of stocks or for other reasons, research on and regulation of specific stocks as defined in (i) is impracticable;

(b) All States fishing the resource, and adjacent coastal States should have the opportunity of joining the convention and of participating in the consideration and discussion of regulatory measures;

(c) Conservation regulations introduced under a convention should be based on scientific research and investigation;

(d) All signatory States should so far as practicable participate directly or through the support of a joint research staff in scientific research and investigation carried out for purposes of the convention;

(e) All conventions should have clear rules regarding the rights and duties of member nations, and clear operating procedures;

(f) Conventions should clearly specify the kinds or types of measures which may be used in order to achieve their objectives;

(g) Conventions should provide for effective enforcement."

This decision of the Conference should be given particular attention, for it sets up guiding principles in formulating Conventions, mentioning specifically that:

(1) The stocks-of-fish approach should be used, except where factors prevent this, such as the intermingling of stocks;

(2) The Conventions should be open-ended so that other interested States may adhere and participate in the program;

(3) The Conventions should be implemented through a joint research agency whenever practicable, rather than through disconnected research bodies.

(4) They should express in clear terms the rights and duties of the parties, the operating procedures, and the types of measures contemplated; and that

(5) They should provide for proper enforcement of conservation regulations against the fishermen concerned so as to prevent the convention's defeat by loose or non-compliance.

"Nothing in these guiding principles is intended to limit the opportunity of States to make agreements on such other fishery matters as they may wish, or to limit the authority or responsibilities of a State to regulate its fisheries on the high seas when its nationals alone are involved."

This is another way of saying that the guiding principles set forth in these conclusions are not intended to have any limiting effect beyond their obvious scope.

"The Conference considers that conventions, and the regulatory measures taken thereunder, should be adopted by agreement among all interested countries. The Conference draws attention, however, to the problems arising from disagreements among States as to scientific and technical matters relating to fishery conservation. Such disagreements may arise to:

(a) The need for conservation measures or the nature of any measures to be taken; and

(b) The need to prevent regulatory measures already adopted by one State or by agreement among certain States from being nullified by refusal on the part of other States, including those newly participating in the fishery concerned, to observe such measures.

"A solution to such problems might be found through:

(a) Agreement among States to refer such disagreements to the findings of suitably qualified and impartial experts chosen for the special case by the parties concerned, with the subsequent transmittal of the findings, if necessary, for the approval of the parties concerned, and

(b) Agreement by all States fishing a stock of fish to accept the responsibility to cooperate with other States concerned in adequate programmes of conservation research and regulation."

The two foregoing paragraphs merely take cognizance of possible disagreement between interested States and suggest ways of resolving them. The International Law Commission has taken note of this aspect of the problem, as is reflected in a series of draft recommendations, one of them relating to arbitration, which it developed at its session at Geneva last spring.

"The Conference recognizes that a problem is created when the intensive exploitation of offshore waters adjoining heavily fished inshore waters, by a new fishing operation initiated by another State, considerably affects the abundance of fish in the inshore waters. This conservation problem is taken care of when the entire area is included in a conservation system involving the concerned States, and is subject to conservation regulations adequate to maintain the maximum sustainable yield. However, when no such system exists, overfishing may occur before suitable arrangements and regulations can be developed. Opinion in the Conference was more or less evenly divided as to the responsibility of the coastal State under such circumstances to institute a conservation programme for the fisheries concerned, pending negotiations of suitable arrangements. This problem requires further study."

This conclusion likewise recognizes a specific kind of problem that could evolve from a situation where the stock of fish in question lies both inside and

outside of territorial waters and the concerned states fail to agree on a common conservation program. The International Law Commission has likewise taken special account of this in its present consideration of high seas fisheries by providing for unilateral action under very strict conditions.

"It was the consensus of the Conference that it was not competent to express any opinion as to the appropriate extent of the territorial sea, the extent of the jurisdiction of the coastal State over fisheries, or the legal status of the superjacent waters of the continental shelf."

The Delegations of Chile, Ecuador and Peru filed the only reservations to these general conclusions. The results of the work at Rome were carried to Geneva within a matter of hours and placed in the hands of the International Law Commission, which was then in session. New draft articles on high seas fisheries resulted, and are presently being circulated by the International Law Commission for comment by members of the United Nations.

DISCUSSION

Biological Session

Discussion Leader: PAUL THOMPSON

Discussion Panel: ERNEST MITTS, PETER LARKEN, W. W. ANDERSON

International Waters and the Fisheries

FREDERICK TAYLOR

Q. Anderson: In setting up international regulations on any fishery, would the seaward jurisdiction claimed by any nation or perhaps state be recognized in promulgating those regulations?

A. Fred. Taylor: There is a difference of opinion between many states in the world as to the legitimate extent of the sovereign territory. There have been claims advanced to as far as 200 miles from the coast in the name of sovereignty and for the stated purpose of preserving the fishery resources of those waters. In the United States there is a three mile belt of territorial waters which is maintained. It comes into direct conflict with the 200 mile claims, particularly in respect to enforcement for conservation of fisheries in these waters. Sovereign nations are loath to relinquish the jurisdiction to prosecute a violator of conservation regulations to a foreign state if they feel the violation occurred in their own waters. It resolves into who is going to enforce the regulations and who is going to try violations. The United States will not relinquish the jurisdiction to prosecute internationals of a foreign state when the violation occurs in waters as yet regarded as high seas. That difference of national position on territorial waters enters into the conservation picture.

Q. Larkin: Costa Rica has adhered to the Santiago Declaration, which means that they have accepted the claims of Peru, Chile and Ecuador to 200 miles off their coasts. How is that likely to affect the tuna conservation commission in which the United States has such a great interest?

A. Fred. Taylor: The governments of Peru, Ecuador and Chile are the three that are identified with the Santiago Declaration of 1952, out of which this 200 mile claim came. We were informed that a protocol has been negotiated which would amend that Santiago Declaration, enabling other states to adhere to it. This would have the effect of causing any other state which signed the protocol to recognize the 200 mile principle. If my understanding is correct, this would amount to a declaration by Costa Rica constituting endorsement of the 200 mile principle. Costa Rica is a full party with us in the Tropical Tuna Commission. The Commission is concerned with the waters of the eastern Pacific, in which certain stocks of fish are found. The area covered embraces without distinction waters both inside territorial waters and the high seas outside territorial waters. Therefore the approach is on the stocks of fish basis rather than upon the geographical breakdown. In that way it is not necessary to decide where territorial waters begin and where they end. I would assume that even if there were a 200 mile claim advanced by Costa Rica and these other countries, so long as a distinction was not drawn between territorial waters and waters outside, the extent of territorial waters would not become really important to the continued work of this Commission.

Q. Fieger: I would like to know how the United States reconciles its three mile limit as sovereign waters and claims ownership of the oil under the waters out to the end of the continental shelf.

A. Fred. Taylor: The concept of the continental shelf and its resources is new; there is no long standing rule or custom relating or pertaining to it by which nations might be considered bound. Therefore, new rules may be promulgated with respect to it. The United States in 1945, by a precedence of proclamation, said that the resources of the continental shelf appertain to the jurisdiction and control of the United States, and is subject to its powers of disposition. In theory there is a possible lateral division between sovereignty over what is below and no sovereignty of what is above the bottom.

Q. H. Taylor: Is there any need at all for international regulation of fisheries?

A. Fred. Taylor: A great number of examples can be cited where international cooperation through commissions have rehabilitated fisheries and have prevented their over-exploitation, and protected them for posterity. We are not in this day and age desirous of waiting until a fishery resource has been struck down before trying to do something for it.

Q. Whiteleather: If the principles of the International Law Commission are generally adopted, say by a majority vote in the U. N. General Assembly in the near future, how are the number of nations of the U. N. bound by these principles?

A. Fred. Taylor: In assigning this particular study to the International Law Commission, the General Assembly of the U.N. did not indicate how it intended to implement any recommendations emanating from the International Law Commission. If there is substantial agreement on a set of articles on which the Law Commission is expected to make recommendations, a convention would be opened for that purpose and it would not be the subject of a majority decision from the United Nations. A convention would be opened for signature and ratification, binding against only those who did in fact sign and ratify. This would be a voluntary act on the part of the individual governments, in the form of a convention.

Q. Gilbert: Are there any articles in the International Law Commission that govern the possibility of forcing a nation to join in a convention for conservation of the population of fish when it does not do that particular nation any good?

A. Fred. Taylor: If a newly entering state does not comply with the existing regime, the matter will be taken to a Board of Arbitration.

Principles in Arbitrating Disputes Between Commercial Fisheries and Sponge Fisheries

J. L. McHugh

Q. Mitts: What methods in your educational program have you found to be most effective?

A. McHugh: The television programs have been the best, because of the coverage. We also use newspapers, and have had a great success with this.

Q. Hoover: Is it true that in some cases the sports fishermen compete seriously with the commercial fishermen?

A. McHugh: This is true, particularly with regard to striped bass. We have had no complaints of the sort where the sports fishermen sell their catch.

The Management of an East Coast Fishery

Gerald Talbot

Q. W. W. Anderson: What is the definition of depletion?

A. Talbot: Dr. Schaefer answered that very well several years ago. His definition of depletion was when the production of a fishery gets below its maximum productivity level it is then depleted. We are striving in our work to get the most out of a fishery that we can on a continual yield basis. When we are not

getting that because a fishery stock has been reduced to a low level, then I would say that we are in a state of depletion, with some more serious than others.

Q. W. W. Anderson: In maintaining the population of shad in a river, what is the most important factor contributing to this?

A. Talbot: In managing the fishery, the first thing we need is good fishery statistics.

Q. Greer: How do you figure tagging mortality?

A. Talbot: We found that tagging had little effect on the fish.

Q. Greer: Have you any data on the tagged fish staying together?

A. Talbot: Apparently they do stay together during their migrations.

Principles in Regulating Shrimp Fisheries

GORDON GUNTER

Q. W. W. Anderson: How important are social and economic problems when regulating a fishery of this type in inshore waters?

A. Gunter: There are a great number of things to be considered, before any decision could be made. The regulations which I have suggested are largely on a value basis, because this is the way the fishermen operate. The important thing is the proper utilization of the shrimp during any given year.

Q. Larkin: Is the mortality rate in the order of 96% a week, and if so, would it not pay to harvest the small shrimps?

A. Gunter: If the mortality rate were that high, I do not believe any of them would last for a year. The point of highest mortality is on the drifting larvae. After they get into the bays, they are in an area where they have more enemies. In the beginning they are somewhat protected from the larger fish by their very small size, and they live on the bottom. I suspect that the time spent in the bays is the period when mortality is the lowest. The 60 count shrimp is on the edge of being economically useful, but if those shrimp increase to a 30 count shrimp in seven days they are worth a great deal more. From a standpoint of value, you can have half as many, or possibly even a quarter as many, shrimp and get as much money for them. You have to have a terrifically high mortality to offset that fast growth rate.

Q. Strasburger: Did I understand you correctly to say that 60 count shrimp were on the borderline of economic feasibility? If that is true, how do you account for the use by canneries and dryers of large amounts of shrimp of sizes from 100 to 120 to the pound?

A. Gunter: There are some shrimp caught in Louisiana which are not of the species we are treating. I am glad to know that they are using such small shrimp; I saw those small shrimp canned several years ago, but I thought they had abandoned it.

Strasburger The shrimp to which I refer are the small brown shrimp

(Comment): which are canned in the spring, starting in April and running through June. They are canned in Louisiana, and they are one of the three species of which we were speaking. Their use has become so extensive that in developing grade standards a new classification was added about two years ago utilizing the term "tiny" to cover these small shrimp which were being canned.

Q. Strasburger: You infer that the growth rate is very rapid, and that the shrimp increase will go from a 60 count shrimp to a 30 count shrimp within approximately seven days. If that is the case, how would you account for the appearance, in the exact same area, of shrimp which maintain approximately the same size, and show very little size differences during the peak period of growth. I would say that it takes about five to seven weeks for the change of 60 count shrimp down to a 25 or 30 count shrimp.

A. Gunter: I would account for that by "feeding in" to the population of shrimp which were below a catchable size at the time the fishermen were fishing. For a good many years it was always a puzzle to me as to where the shrimp came from so suddenly in the fall. In the latter part of August and September, they suddenly come in in the thousands of pounds. They apparently came in from the tiny shrimp which you could catch if you had plankton nets. They grew apparently that fast. I think those shrimp grow and move on out and other little ones are entering all the time from that subcommercial population. This will hold the size limit down. You can fish in certain areas and measure all the shrimp caught, and the size of the average will decline; it will not go up nor be maintained, but decline. I think that is because the small shrimp are entering faster than they have been before.

Q. Strasburger: This summer boats out of Biloxi were fishing brown shrimp off Horn Island area. They started off approximately in the middle of June, and in general the small shrimp were roughly 75 to 80 per cent of the catch, running around a 50 to 60 count. It was the latter part of July before those shrimp had gone to a 30 count shrimp.

A. Gunter: We made studies of how many shrimp were to be found on the bottoms on various areas, and the results were very surprising. The amounts were very small, and led Burkenroad to suggest that possibly there are less shrimp present on the whole fishing grounds at any one time than the annual production of the whole area. If that is the case, then it is unique in any fishery as far as I know, and can only be explained by this fast growth rate.

FRIDAY—NOVEMBER 4

Chairman—R. T. WHITELEATHER, *Assistant Chief, Branch of Commercial Fisheries, Fish and Wildlife Service, Washington, D. C.*

The Effect of Aureomycin* Chlortetracycline on Fish Freshness

M. C. FIRMAN, A. ABBEY, M. A. DARKEN, A. R. KOHLER, S. D. UPHAM

American Cyanamid Company, New York, N. Y.

WITH THE PRESENT DAY system of food handling and storage, a large part of the consumer market cannot hope to purchase fish within one day of its catch. Our vast system of marketing with its processors, terminal markets, and dealers, as well as long distance hauling has made improved methods of storage of food a vital necessity. The ever-increasing market, more distant from the sea, has made the process of keeping fish as fresh as possible almost as important as the catch itself. To date, the delivery of fresh fish has depended on ice or refrigeration to maintain this freshness. Now the need has become apparent for a means of holding that freshness longer. The purpose of this paper will be to present an answer to this need.

Tarr and co-workers (Tarr, 1944; Tarr and Deas, 1948; Bissett and Tarr, 1952; Tarr, Southcott and Bissett, 1952; Boyd Brumwell and Tarr, 1953; Tarr, Boyd and Bissett, 1954) for a number of years have been investigating additives for increasing the storage life of cod and salmon. In 1952 they reported success with antibiotics and particular success with chlortetracycline. They found that the bacterial spoilage of whole eviscerated fish was retarded significantly by chilling with ice containing one to four ppm of chlortetracycline by holding fish six days at —1°C in sea water containing three ppm chlortetracycline, or by a brief immersion in a 50 to 100 ppm chlortetracycline solution prior to icing. Tarr further found that chlortetracycline is fairly stable in flesh at low temperature but is readily destroyed upon heating. More recently Farber (1954) described the action of chlortetracycline on a number of fish and shellfish.

Deatherage and co-workers (Cahill, et al, 1952; Lepovetsky, et al, 1952; Goldberg, et al, 1953; Weiser, et al, 1953; Weiser, et al, 1954) have reported that the infusion of chlortetracycline inhibits bacterial growth in beef, while Kohler et al (1955) have shown a similar control in poultry.

One of the most perplexing problems associated with the determination of fish freshness is a reliable laboratory test. For our purposes microbial counts as well as organoleptic observations of odor appeared best. Experiments were conducted to establish a standardized procedure for this test.

Tarr reported microbial counts obtained by incubating for 24 hours at 10°C a one-inch center cut steak of the fish.

*Trademark of American Cyanamid Company for the antibiotic chlortetracyline is Aureomycin.

Table 1 shows the results of microbial counts made on mackerel purchased at a local store. One-inch center cut steaks were blended with three parts sterile distilled water. A duplicate steak was incubated 24 hours at 10°C prior to blending. Appropriate dilutions were made and bacterial counts were carried out on Difco Nutrient Agar, Difco Nutrient Agar prepared with sea water and ZoBell's Marine Agar (ZoBell, 1946). Counts were read after a 48 hour period at 25°C.

The data indicates that:

1. non-marine contamination predominates.
2. higher counts followed incubation technique.

The standardized procedure adopted for this work was to blend a one-inch center cut steak with three parts sterile distilled water. Appropriate dilutions were made and plated out on Difco Nutrient Agar. Plates were read after 48 hours at 25° C.

TABLE 1—Mackerel
Initial Microorganisms x 10^6 per Gram Fish

Incubation Period	Nutrient Agar	Sea Water Agar	Marine Agar
None	0.031	0.009	0.008
None	0.009	0.006	0.0004
24 Hours	0.043	0.010	0.0024
24 Hours	0.037	0.007	0.0008
5 Days Storage Microorganisms x 10^6 per Gram Fish			
None	11.1		
None	3.7		
24 Hours	184.0		
24 Hours	78.0		

The method of application of chlortetracycline to fish depends on the usual mode of handling. It may be by chlortetracycline ice for those fish which are usually iced round or gutted. A chlortetracycline dip might fit best those fish that are usually handled with a rinse or pre-chill. A freezing brine containing chlortetracycline would suit best in the instance where fish are frozen by the immersion process.

An experiment was conducted to determine the uptake of chlortetracycline in fish treated with chlortetracycline. Whole butterfish and scrod steaks were treated by a 10 minute dip in fresh or sea water solution containing 10 ppm chlortetracycline. Samples were also frozen in a 22 per cent brine with 10 ppm chlortetracycline held at —12°C.

The chlortetracycline residue of the fish was determined by pad plate assay (Grady and Williams, 1953) measuring the inhibition of the material against *B. cereus* No. 5. An extract of the sample was prepared by blending five g in 25 ml of an acid acetone mixture composed of acetone 650 ml, distilled water 333 ml, and HCl 17 ml. Paper discs were dipped in the extracts and air dried for two to three hours at room temperature. The dried discs were laid on flat bottom Petri dishes containing 10 ml of Brain Heart Infusion Agar inoculated with *B. cereus*. After incubation the inhibitory zones were measured and the values calculated from the standard curve ranging from five to 0.025 mcg/ml chlortetracycline.

The data in Table 2 indicate that scrod steaks or whole butterfish may be treated effectively by sea or fresh water immersion or in a freezing brine containing chlortetracycline.

TABLE 2

SCROD STEAK AND WHOLE BUTTERFISH

Fish	Treatment	Chlortetracycline mcg/g Fish
Scrod steak	CTC 10 ppm tap water	5.5
Scrod steak	CTC 10 ppm sea water	4.5
Scrod steak	Freezing brine 22% + CTC 10 ppm	3.5
Whole butterfish	CTC 10 ppm tap water	1.33
Whole butterfish	CTC 10 ppm sea water	0.4
Whole butterfish	Freezing brine 22% + CTC 10 ppm	0.82

Ice containing five ppm chlortetracycline was prepared according to the method described by Upham et al, 1955. A number of species of fish were treated with chlortetracycline ice or with a dip in combination with chlortetracycline ice and the residual level determined.

TABLE 3

UPTAKE OF CHLORTETRACYCLINE IN MCG/G FISH

Fish	Treatment Dip	Ice	Steak	Flesh
Sea Bass	None	CTC	0.43	0.28
Sea Bass	5 ppm sea H_2O	CTC	1.55	0.25
Butterfish	None	CTC	0.54	0.38
Butterfish	5 ppm sea H_2O	CTC	0.98	1.1
Porgy	None	CTC	0.5	0.31
Porgy	5 ppm sea H_2O	CTC	1.58	0.25
Weakfish	None	CTC	0.05	0.7
Weakfish	10 ppm sea H_2O	CTC	1.6	0.37
Weakfish	10 ppm tap H_2O	CTC	0.88	0.18
Croaker	None	CTC	0.30	0.38
Croaker	10 ppm sea H_2O	CTC	0.30	0.20
Croaker	10 ppm tap H_2O	CTC	0.26	0.16
Scrod, Boston	None	CTC	2.4	-
Scrod, New Bedford	None	CTC	0.91	-
Salmon	None	CTC	-	0.09
Halibut	None	CTC	-	0.8

The data in Table 3 indicate that fish do take up chlortetracycline.

A series of tests were run on a variety of species of fish from a number of geographical locations to determine if an extension of storage life could be obtained.

Laboratory specimens of sea bass were obtained off the coast of New Jersey. Samples were packed in chlortetracycline ice, regular ice, and samples were also dipped 30 minutes in a five ppm chlortetracycline sea water solution prior to packing in chlortetracycline ice. After delivery to the laboratory, samples were held in the refrigerator until the bacterial counts were carried out by the standard procedure as outlined before.

TABLE 4—Sea Bass

Treatment		Total Microorganisms x 10^6 per Gram Fish		
Dip (5 ppm)	Ice	4th Day	7th Day	11th Day
None	Regular	980.0	8200 A	17,000 A
None	CTC	28.0	1700 C	11,000 A
CTC	CTC	1.4	770	840 A

A - putrid
B - strong odor
C - medium odor
D - slight odor

The data in Table 4 indicate that a chlortetracycline dip followed by chlortetracycline ice was the most effective preservative treatment. Although the storage life was extended beyond that of the control by chlortetracycline treatment, it should be pointed out that these samples were stored in a refrigerator not in the presence of chlortetracycline.

Samples of weakfish and croakers were dipped and iced on another trip off the New Jersey coast. The dips were prepared using 10 ppm chlortetracycline in both sea and fresh water. The water was drawn early and permitted to stand on deck until a uniform temperature of 15°C was reached. The fish were dipped 20 minutes and then iced in individual containers with chlortetracycline ice. In addition, individual containers of fish were iced under chlortetracycline ice or regular ice and held in this manner for the entire storage period.

The effectiveness of chlortetracycline in extending the storage of weakfish and croakers was clearly shown in this experiment. The data in Table 5 indicate that:

1. The storage life of weakfish is extended to the 15th day by chlortetracycline ice over the control life of eight days;
2. The extension of the storage life from 8th to the 15th day by a dip followed by chlortetracycline ice.

TABLE 5—Weakfish

Treatment		Total Microorganisms x 10^6 per Gram Fish					
Dip (10 ppm)	Ice	1 Day	4 Days	8 Days	11 Days	15 Days	18 Days
None	Regular	0.013	0.35	14.0 D	132.0 C	452.0 B	636.0 B
None	CTC	0.038	0.14	1.7	5.4	15.6 C	58.4 C
Sea H_2O	CTC	0.032	0.10	0.6	2.7	12.4 D	64.0 C
Fresh H_2O	CTC	0.054	0.51	0.5	3.2	15.2 D	80.8 C

B - strong odor
C - medium odor
D - slight odor

The data in Table 6 show that:

1. The decay in croakers was retarded from the 8th to the 15th day by chlortetracycline ice alone or in combination with the dip;
2. No detectable difference by odor or microbiological count between fish dipped in sea water or fresh water preparations of chlortetracycline.

TABLE 6—Croaker

Treatment		Total Microorganisms x 10^6 per Gram Fish					
Dip (10 ppm)	Ice	1 Day	8 Days	15 Days	18 Days	21 Days	25 Days
None	Regular	0.064	5.6	240.0	320.0	320.0	552.0
None	CTC	0.032	1.4	23.2	39.6	61.6	56.0
Sea water	CTC	0.040	0.852	15.6	10.5	47.2	128.0
Fresh water	CTC	0.021	0.788	11.8	10.9	28.8	43.0

Samples of scrod taken out of New Bedford, Massachusetts, were iced under chlortetracycline ice or regular ice on shipboard. At the dock the samples were frozen and sent to the laboratory. After thawing they were kept on their respective ices for the test period. Storage time was taken as the days under ice not frozen.

The data in Table 7 demonstrate that chlortetracycline ice was effective in retarding the decay of scrod as evidenced by organoleptic findings and bacterial counts from the 22nd day to the 36th.

TABLE 7—Scrod (New Bedford)

Treatment	Total Microorganisms x 10^6 per Gram Fish				
Ice	8 Days	15 Days	22 Days	29 Days	36 Days
Regular	0.012	8.4	14.4 D	520.0 C	884.0 A
CTC	0.003	0.03	2.6	20.8	30.8 D

A - putrid
B - strong odor
C - medium odor
D - slight odor

Scrod obtained out of Boston, Massachusetts, showed a similar pattern.

TABLE 8—Scrod (Boston)

Treatment	Total Microorganisms x 10^6 per Gram Fish					
Ice	12 Days	16 Days	19 Days	22 Days	25 Days	28 Days
Regular	0.23	3.6	20.0 D	102.0 B	484.0 A	-
CTC	0.006	0.021	0.044	0.96	7.5	45.2

A - putrid
B - strong odor
C - medium odor
D - slight odor

The data in Table 8 indicate that chlortetracycline ice extended the storage life from the 19th to the 28th day as evidenced by odor and microbiological count.

Troll caught king salmon and halibut were obtained at Neah Bay, Washington. After evisceration, some fish were iced with chlortetracycline ice and others with regular ice and shipped to the laboratory under commercial handling conditions. The fish were trucked to Seattle and then shipped to New York by rail. They were in transit 13 days with one re-icing on the 6th day. The effectiveness of chlortetracycline ice under commercial handling conditions was clearly shown in this experiment.

The results obtained by organoleptic findings and bacterial counts shown in Table 9 indicate that decay in salmon was retarded by chlortetracycline ice to the 20th day over the control at 13 days. The salmon on regular ice upon receipt in the laboratory had a slight off-odor and was lighter in color with brown discolorations throughout. The salmon on chlortetracycline ice had a fresh sweet odor and a uniform pink color.

TABLE 9—Salmon

Treatment Ice	Total Microorganisms x 10^6 per Gram Fish 13 Days	16 Days	20 Days	22 Days	26 Days
Regular	28.4 D	91.6 C	424.0 A	712.0 A	
CTC	0.59	0.74	4.8 D	40.8 C	73.2 B

A - putrid
B - strong odor
C - medium odor
D - slight odor

The halibut handled in the same shipment had on arrival a strong odor throughout the entire fish and the flesh felt weak and soft. The chlortetracycline iced halibut had a slight off-odor in the gill cavity only. The flesh was firm.

TABLE 10—Halibut

Treatment Ice	Total Microorganisms x 10^6 per Gram Fish 13 Days	16 Days	20 Days	22 Days	26 Days
Regular	32.4 B	95.6 B	652.0 A	920.0 A	
CTC	0.12	0.15	3.0 D	69.2 C	108.0 A

A - putrid
B - strong odor
C - medium odor
D - slight odor

The bacterial counts shown in Table 10 indicated that decay was extended to the 20th day from a time previous to the 13th day as the controls were unacceptable when received by the laboratory on the 13th day.

Summary:

It has been clearly demonstrated by organoleptic observations and microbial counts that chlortetracycline is effective in prolonging the shelf life of fresh fish. The chlortetracycline may be applied as an ice, a dip, or a freezing brine. It is obvious that the choice of treatment is best determined by the present handling conditions. This, then, is offered as a means of keeping the quality of freshness so direly needed for our increasing market farther from the sea.

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The Use of Indole as an Indicator of Spoilage in Fresh Shrimp

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Some objective test of shrimp quality is urgently needed by the industry to assist buyers and to help in the establishment of quality standards, and in the proper application of regulatory laws. One of the tests used has been to measure the quantity of indole produced during storage periods.

Tryptophane, an amino acid which is produced by the catalytic action of the enzyme tryptose upon the hydrolysis of albuminous matter is subject to various changes which eventually yield indole, among other substances.

The presence of tryptophane in crustacean and mollusk proteins was demonstrated by Jones and Okuda (Winton, 1939).

Para-dimethylaminobenzaldehyde, the main ingredient of Ehrlicks reagent, is known to react with indole under certain conditions, to form a red color. Chernoff (1940) developed a method to determine this color quantitatively, by setting up a series of standard solutions of varying concentrations for visual comparison. Clarke et al (1937) adapted the method for the determination of indole in dairy products, and introduced the use of the photometer.

King, Flynn and Gowanloch (1945) proposed the use of indole to detect decomposition in oysters. They also noted in fresh oysters the presence of some interfering substance that reacted with p-dimethylaminobenzaldehyde similarly to indole. Beacham (1946) found larger quantities of this indole reacting material in clams. Duggan and Strasburger (1946) observed that there was a relation between the indole content and the stage of decomposition organoleptically detected in shrimp. In later studies with shrimp, oysters and crabmeat, using samples containing amounts of indole that might be encountered in commercial samples, it was found that the greatest variations were in the shrimp samples (Duggan 1948). These inconsistencies were attributed to sampling errors and to the inexperience of the chemist with the method.

Experimental Procedure

The shrimp used in these tests were the pink spotted shrimp, *Penaeus duorarum*, caught in the Key West-Tortugas Grounds. All samples were collected personally by the investigator on board the fishing vessels, and their precise history is known. The shrimp were deheaded immediately after capture, carefully washed with sea water and stored in the hold in boxes containing snow-type ice. The shrimp were re-iced a number of times en route to The Marine Laboratory. Upon arrival at the Laboratory they were transferred to insulated storage bins. In the first experiment the shrimp were stored in crushed "Rickey" type ice, and in the second experiment in flake ice. Indole determinations were made on shrimp samples drawn every two days, starting with the second day of iced storage. Samples were drawn at regular intervals and tested throughout a nineteen day period in the first experiment, (Figures marked "A") and over a twenty-two day period in the second (Figures marked "B"). Organoleptic and bacterial tests were made at more irregular intervals. Indole content was compared to organoleptic scores, as determined by an experienced test panel, and to bacterial scores. The organoleptic criteria used were odor and taste. Bacterial counts were made by the direct count method as modified by Tarr (1941). To minimize sampling errors which had been experienced by previous investigators, simultaneous determinations were made with two sets of apparatus. The indole quantities represented here are the averages of two determinations, which has resulted in a marked smoothing of the original lines. Figures 1-3 compare indole production with odor, taste and bacterial scores.

As stated above, the basic method used by all workers was that of Clarke (1937) et al. King, Flynn and Gowanloch (1945) modified Clarke's method in that no Reichert-Meissel bulb and no stop cock lubricant were used, water instead of alcohol was used in the distilling flask, and steam rather than alcohol was used to wash the condenser. Beacham (1946) further modified the method in that an all-glass apparatus was used, thereby eliminating

any interference from rubber stoppers. The distillate was made alkaline before extraction with chloroform and sodium sulfate was added to prevent the formation of emulsions. Before the addition of the color reagent the extract was shaken with HCl to partly eliminate the apparent indole. Acetic acid alone was used to develop the color of the phosphoric acid-aldehyde extract rather than an acetic acid-ether mixture. Duggan and Strasburger (1946) followed essentially the same procedure as Clarke except that all rubber stoppers were covered with tin foil, as unprotected natural or synthetic rubber connections may cause variable distillation blanks. Actual distillation time was reduced from the 90 minutes of Clarke et al to approximately 45 minutes. Also the following experimentally determined facts were observed by Clarke and his co-workers.

(1) No differences in recovery of indole are discernible when water is substituted for alcohol, except that less total distillate is required.
(2) No indole is obtained in the first 100 ml of distillate when 100 ml or more of alcohol is present in the distilling flask.
(3) Approximately 60 per cent of the indole present is found in the first 100 ml distillate coming over after the alcohol has distilled off.
(4) When not more than 150 ml of alcohol is present in the distilling flask 95-100 per cent of the indole present is contained in the first 450 ml of distillate.
(5) Continued distillation beyond the 450 ml of distillate required in the procedure does not form any indole in fresh shrimp (raw or cooked).
(6) Continued distillation of decomposed shrimp beyond 450 ml does not form any indole. A small amount (3-4 per cent of the total) of indole is found in the second 450 ml distillate. Only one or two micrograms are found in the third and fourth 450 ml distillate. This amount was not considered significant when the original concentration of approximately 500 micrograms was considered.
(7) Traces of chlorine and bromine in the water will destroy the indole in the determinations.

The technique used by the present investigators was that of Clarke, as modified by the above workers. The procedure follows:

I. Preparation of Reagents:

(a) Color Reagent
Dissolve 0.4 g of p-dimethylaminobenzaldehyde in 5 ml of acetic acid and mix with 92 ml of phosphoric acid and 3 ml concentrated HCl. Mix the color reagent in 100 ml or 500 ml lots. Purify p-dimethylaminobenzaldehyde according to A.O.A.C. *20,* 477 (1937). The purity of this reagent exerts a strong influence on the intensity of the reagent blank.

(b) Acetic Acid
If this reagent gives a pink reaction with the color reagent, purify by distilling in an all glass still 500 ml with 25 g $KMNO_4$ and 20 ml H_2SO_4.

(c) Hydrochloric Acid
A 5 per cent solution.

(d) Sodium Sulphate
A saturated aqueous solution.

(e) Chloroform
U.S.P.

(f) Standard Indole Solution

Weigh accurately 20 mg indole into a 200 ml volumetric flask and dilute to mark with 95 per cent alcohol. Prepare working solutions fresh daily. Keep stock solution refrigerated and do not use after two weeks. If Eastman White Label (M.P. 52°-53°C) indole is used the standard solutions are reported to be stable for months if kept refrigerated and protected from the light.

II. Distillation Apparatus:

Use a separate steam generator for each unit. The generator itself may be made from a one liter Erlenmayer flask and connected to an all-glass still by means of polyethylene tubing. The 500 ml distillation flask is connected to a vertical straight bow condenser through a spray trap. Use foil-covered rubber stoppers in the steam generator.

III. Procedure:

(a) Distillation

Weigh two or three shrimp and place them in a blendor; add 80 ml alcohol and mix the sample for several minutes until a smooth homogeneous mixture is obtained. The mixture is then transferred to the distillation flask, and a minimum amount of alcohol used to rinse the blendor.

A few drops of Dow Corning Antifoam "A" are added and the flask then connected to the steam distillation apparatus. Sufficient heat is applied to the distillation flask to maintain an 80-90 ml volume. About 450 ml of distillate should collect in approximately 45 minutes. Steam should be used to wash the condenser.

(b) Extraction

Transfer the distillate to a 500 ml separatory funnel, add 5 ml dilute HCl and 5 ml sodium sulfate solution. Extract successively with 25, 20 and 15 ml portions of chloroform. Shake each portion vigorously for at least one minute. Combine and wash the 25 and 20 ml extracts in a 500 ml separatory funnel with 400 ml water, five ml sodium sulfate and five ml dilute HCl. Save the wash water. Filter the combined extracts through a plug of cotton into a dry 125 ml separatory funnel. Wash the 15 ml portion with the same wash water, and combine with the other portions in the 125 ml separatory funnel.

IV. Development of the Color:

Add 10 ml of the color reagent to the combined extracts and shake vigorously for exactly two minutes, and allow to settle as completely as possible. Drain off 9.0 ml and dilute to 50 ml with acetic acid. Mix well and transfer to a suitable photometer cell and measure the color photometrically at 567 millimicrons. The color solutions may be diluted with acetic acid provided that the blanks are determined at the same dilution. Calculate indole in terms of micrograms per 100 grams of shrimp.

V. Determination of the Standard Curve and Blank:

Prepare a standard curve by steam distilling a series of known amounts of indole. Determine the distillation blank in a like manner omitting the addition of indole.

Experimental Results

Fresh shrimp (up to two days in iced storage) contained little or no indole (0 to 0.5 gammas/100 g of shrimp): A general increase in the amount of indole present occurred with increased storage time in ice (Figures 1-3). The

trend is unmistakable in all of the graphs drawn, but the curves show irregularities in indole production. Inconsistencies and fluctuations in the yield of indole have presented a special problem. For example, shrimp nine days in storage contained less indole than did those five days in storage, and shrimp stored sixteen days exhibited less indole than those stored twelve days. As extremes it may be noted that in one case shrimp twelve days in storage, and in another case shrimp fourteen days in storage showed no indole in one of the determinations.

The above-mentioned anomalies could be attributed to the following factors:

(1) Sampling

(2) Size of the apparatus

(3) Experience of the investigator

(1) To test the extent of the sampling error two simultaneous determinations were made in these experiments. Normal variability among individual shrimp, with the resulting difficulty in obtaining an accurate and representative sample, certainly contributed to the sampling error and may, in fact, be the main factor. For example, in producing the inconsistencies noted difference in indole yields of the two samples from the same storage bin are shown in Figure 4.

Obviously the differences in indole production in individual shrimp cannot be avoided. They could possibly be minimized if a larger sample (up to 10 shrimp) were to be used.

To test this possibility a much larger sample (10 shrimp instead of three) was drawn from the storage bin for analysis. It is evident that the use of this larger sample has resulted in a much smoother curve. (Figure 5)

The use of 50 grams of shrimp per determination from the larger, blended sample has yielded results which are more consistent.

(2) By chance the two distillation units used in the first experiments had spray traps and condensing tubes of different sizes.

Size of Apparatus Used in the Experiments

Part	Apparatus A	Apparatus B
Length of Water Jacket	580	580
* Inner Tube Diameter	10.9	18.2
* Outer Tube Diameter	17.8	24.6
Spray Trap	61	72

* Outer diameter

About half-way through the experiment it was suggested that the interchanging of the different-sized parts might be contributing to the anomalies in the results. A record was therefore kept of the yield of indole for each distilling unit. Where such data were available the largest yields were invariably obtained from the smaller apparatus. Verification of this was obtained by running known quantities of indole in two distilling units.

TABLE I

PERCENTAGE RECOVERY USING TWO DIFFERENT SETS OF APPARATUS

Concentration gamma/ml	*Percentage unit A*	*Recovery unit B*
40	96.0	88.7
60	91.5	90.0
80	97.6	94.0
100	95.5	93.0
Average	95.2	91.4

These differences were found to be statistically significant. It was therefore concluded that the size of the apparatus also has an appreciable influence on the indole yields. Clarke (1938) and Hillig (1942) in their work with volatile fatty acids mention similar difficulties with apparatus.

(3) It is thought that personal error, characteristic of individual investigators, is a factor determining to some extent the results obtained by this technique. However, the consistency of results which were obtained in the present experiments after a certain facility was attained as a result of experience, encourages the belief that this factor can be made insignificant.

Conclusion:

Sampling errors, characteristics of the apparatus, type of equipment, personal error and the time involved in distillation, extraction and spectrophotometric procedures prevent the use of the indole method as a universal criterion for shrimp freshness and as a means of rapid detection of spoilage of shrimp.

However, the results of these experiments suggest that indole can be useful as an indicator of spoilage in fresh shrimp, provided that a constant procedure is established and certain precautions are taken to minimize sampling errors. The method can probably be usefully applied within a given laboratory for comparative results.

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Underwater Television in Commercial Fisheries Research

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There are numerous problems in fisheries investigations which might be better answered by direct visual underwater observations rather than by techniques of sampling and analyses. This is particularly true in research in fishery methods and equipments, long hampered by limited access to actual observations of gear in action. Traditionally, fishermen have tended to use proven types of gear. Advances in the design and construction of nets, trawls and other gears have come about largely as the result of trial and error, based upon catch returns. Information obtained by the use of models or divers working with underwater cameras has been helpful and at times rewarding. The operation of such equipment is often difficult and the data obtained cannot always be completely evaluated.

Perhaps the first successful use of underwater television was during the Bikini atom bomb tests by the United States Navy in 1947. Shortly afterward some experiments were carried out in Canada, in the United Kingdom, and in this country at Cornell University. Early in 1951, the British Admiralty using a standard television broadcast unit was able to locate and salvage a sunken submarine. In 1952 the Canadian Wildlife Service applied underwater television to limnological studies in British Columbia.

The initial success with television in marine research prompted the Fish and Wildlife Service to develop equipment for operating fishing gear. This work was assigned to the Service's Exploratory Gear Development Station at Coral Gables, Florida.

Preliminary investigations were conducted in cooperation with the Navy Bureau of Ships, The Marine Laboratory of the University of Miami and

others, through the summer of 1954. This work helped to determine the optimum conditions for the use of underwater television. It was found that in clearer waters, such as those of the Gulf Stream, as much as 50% of natural sunlight could be expected at depths to 25 feet. Somewhat reduced lighting was found in northern latitudes.

By means of comparison of underwater television experiments, and available data on underwater photography, studies were made of atmospheric and surface conditions, the critical angle of sunlight, of the reflection and defraction of light, dispersion and absorption under water. At depths in excess of 30 to 40 feet where light tends to be restricted to hues of blue and green, white and yellow indicated the greatest persistence for observations of trolled lures, otter boards and trawl nets. To overcome the low light levels that prevail in greater depths, the camera and control monitor had to be modified to improve video and definition, so that the maximum picture potential of the chain might be utilized. A special remotely controlled lens aperture device was constructed for use with 16 mm, 25 mm and wide angle or wide angle adapter lenses. Contrary to claims that the sensitivity of the underwater television camera might be as much as one hundred times that of the human eye, a closer figure was found to be three to four times. Lack of light and shadows was found to produce flat, two-dimensional images. Motion of the camera in most instances tended to increase the effect of depth perception. Artificial light sources ranging from standard light bulbs to 1000 watt navy diving lamps also tended to improve depth perception. Under normal lighting conditions at depths of 70 to 80 feet when there is a minimum of light dispersion and scattering of light, the television cameras might have a range of 70 to 80 feet or more. If artificial lighting is used the back-scattering can reduce the effective range of the camera to 10 to 12 feet. Close up views of a few inches' range are also possible.

The camera vehicle has been developed from simple experiments using the camera suspended overside. It features a 360° scanning facility in azimuth and 90° in elevation, and the operation has an almost studio-like control of a view covering complete hemisphere. The basic unit consists of the following: A vidicon TV camera fitted with lens, remote controlled focus and iris assembly fitted into a water tight pressure housing. The pressure housing may be attached to the scanning unit. The image is transmitted to the viewing unit by co-axial and multi-conductor cable. The operator regulates all mechanical and electrical functions, synchronization of signals, quality of image, focusing, and lens aperture from the control and viewing unit. Here at the monitor screen photographic cameras may be used to permanently record the transmitted image. To obtain good results it is important to have a highly stable 110 volt 60 cycle source of alternating current.

In November of 1954, a joint experiment of the service vessels *Oregon* and *Pompano* in cooperation with the Navy Bureau of Ships, the Navy Photo Center, and The Marine Laboratory of the University of Miami featured the first practical demonstration of the use of underwater television in gear research with an experimental midwater trawl as viewing subject matter. Underwater television units were installed aboard the M/V *Oregon* and the *Pompano*. While under tow from the *Oregon* the trawl doors, cables and net openings were observed by means of an underwater television unit streamed astern between the *Oregon's* towing warps, and the *Pompano,* was employed in lateral observations. During the course of these tests excellent observations

were obtained of the performance of the trawl, the doors, floats, leads, spread and opening of the trawl. It was revealed by the television camera that while this gear was apparently fishing as designed it would require some modification. Observations of the webbing at various points revealed evidence of unequal distribution of load to various sections of the net. At times, the trawl and doors as a whole seemed to rotate about a center line, and to have difficulty to maintain a stable fishing depth. Of particular interest were the television camera, observations which showed that the trawl did not act as an inflated bag containing a volume of water exerting a pressure on the twine in all directions. The trawl mouth appeared as a stable, wire cage-like at all test speeds. During most of the tests the cod end of the experimental trawl remained open. At times, however, fish were observed near the net. These fish were seen swimming away easily from the trawl mouth, not as if frightened but as if aware of it. Whether the color of the net and accessories had any effect on their behavior was not known.

The usefulness of underwater television was further demonstrated as a practical gear research tool in Key West, Florida, in January, February and March, 1955. In conjunction with underwater sound experiments carried on at several stations in the Key West shrimping grounds, the power suspension assembly was used with underwater lights. Submerged for periods of twelve to fourteen hours almost around the clock observations were possible. At the appearance of light, pink shrimp were observed to immediately bury in the sea bed. Many other interesting views of marine life were seen and some sound sources identified by means of the television. At one time sounds attributed to the pink shrimp were more properly associated with the Florida lobster.

During experiments with various types of shrimp traps, numerous species of fish and marine life were seen and permanent records made by photography at the monitor screen. Some of these offer sharp detail. It was noted that after a short time many species of fish observed seemed to be unconcerned with the artificial illumination or the television camera.

In March, 1955, the underwater television gear was used to observe a 40 foot flat trawl and a 70 foot balloon trawl under normal dragging operations at depths to 60 feet. With the television unit trained on one of the trawling cables, the warp was followed down to the net. With the remote control scanning facility and by careful positioning of the *Pompano* it was possible to view the shrimp nets from front, top, rear and several angles for extended periods of time. Good close-up views were afforded of twine, doors, floats and lead lines, and while it was shown that these two nets were apparently performing as designed and rigged, it was possible to make adjustments and corrections to improve their fishing ability. Disturbed clouds of coral dust on the bottom revealed no indications of back wash at the trawl mouth on these particular tests. It may be said that an important consideration in the performance of bottom trawls appears to be towing speed. The television cameras revealed that at times an excessive rate of speed resulted in leap-frogging of lead lines or that too slow a rate of speed allowed trawl cables to come at times in contact with the bottom resulting in smaller angle of doors and decrease in net opening.

Of particular interest was the test of the 70 foot balloon trawl, which had not performed satisfactorily. Observations with the television camera were made which revealed that the net was functioning as designed.

During these Key West investigations and while examining local Florida waters for suitable gear proving grounds, the television unit was found to be very useful in delineating bottom types and conditions. A good deal of the success of trawling operations is dependent on bottom conditions which may change or which may not be accurately defined in fishing charts.

Often difficulties are experienced by shellfish operators in locating and efficiently harvesting beds of clams or oysters in waters deeper than 50 feet. The television unit might be of considerable help here and perhaps even allow some forecast of production.

The underwater television gear might also be used for studies of long line gear, gill nets, traps, or other stationary fishing gear. The behavior of fish passing through the webbing or over it could be studied, and observed at all times.

The experience gained thus far seems to indicate an expanded scope and variety of the use of underwater television. How suited the equipment is for a particular operation depends principally upon mechanical applications within the limits of the closed television system. Refinements in television have been rapid and future equipment might even allow 3-dimensional or color television for under-sea use. In comparison with other forms of under-sea observations in terms of depths attainable, risk involved, time of immersion, temperature, mobility, and sensitivity to light and color, the underwater television unit has some definite advantages. The ability of the unit to hover, be placed on the bottom or to be moved through the water for extended periods of observation with no risk to a diver's life is an outstanding advantage.

In summary, it is felt that rather than a novel application, the use of underwater television has been rewarding in scientific studies of fishing gear, bottom surveying, and of the behavior of fishes and marine life. The equipment in its present form is suitable for a variety of research observations. Work is continuing on the development of the proto-type instrument toward a multi-purpose undersea television vehicle. It is felt that with its use, and that of associated visual aids, progress toward more efficient fishery methods and equipment may more rapidly come about and aid in improving the position of the commercial fishermen.

The Seagoing Requirements of Fishing Vessels

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THERE IS PERHAPS no service on the high seas in which the element of seaworthiness is more vital than in fishing. There are a variety of reasons, of which the following are most noteworthy:

1. The work of the offshore fishing vessel is carried on in the open ocean where even the largest—excepting whaling and a few other factory ships—is small when measured against the prevailing sea conditions. To put it a little differently, the sea is almost always rough for the small ship.

2. The fishing vessel, in contrast to the merchant ship, must maintain its position and, if possible, continue to fish, wherever fish are found just so long as wind and sea permit.
3. The fishing vessel must not only be highly seaworthy—stable, watertight and amply powered—she must also provide as steady a platform as possible from which to conduct fishing operations, and tolerable living conditions over a considerable period of time.
4. The fishing vessel must load cargo at sea; in all but a very few modern vessels of radical design, loading still requires the opening of hatches or scuttles for short periods whenever fish are taken aboard. If decks are flooded with hatches open, a dangerous volume of water can enter the fish holds and seriously reduce the vessel's stability and buoyancy.
5. Conditions of loading, displacement and trim alter continuously and often considerably through the exchange of fuel and ice for fish, and through occasional heavy icing of rigging and superstructure on winter voyages in high latitudes, with frequently adverse effect on stability.

The problem of seaworthiness from the common point of view of the fisherman and the fishing vessel is two-fold: on the one hand, the problem is to determine what are the limiting capabilities of the vessel in weather; on the other hand, what can be done to raise these limits. The solution of these problems will realize additional fishing time. Current research in the seakeeping aspects of merchant ships indicates that it may soon be possible to define the upper limits of operational ability with respect to weather, and at the same time, current research in design features holds great promise for the extension of these limits.

What is really needed for the development of better fishing vessels is that the naval architect and shipbuilder be enabled to apply all of the knowledge now available to them to fishing vessel design and construction. The argument is not infrequently heard that the fishing vessel owner cannot afford the luxury of costly engineering advice. In reality, the best professional guidance is no luxury. The owner cannot risk the creation of his expensive vessel without the most skilled and experienced planning.

Expressed in simple terms, the vessel which is cheapest to build and operate and which can catch and deliver the most fish in the shortest time is the most profitable, assuming of course, that a satisfactory price is received. Now the overall efficiency of the fishing vessel is determined in part by the time which is spent in the actual operation of fishing, as distinguished from time spent on the outward and inward voyages, in shifting grounds, and in port. The time spent in fishing depends to a considerable extent on the degree of wind and weather in which the vessel can fish effectively. Hence improvements in seaworthiness which extend fishing capabilities are one way of increasing fishing efficiency as well as safety.

It is misleading to generalize and impossible to examine here the circumstances which are to be met in widely varying fishing activities. This paper will be confined to trawling and trawlers, which represent probably the most arduous fishing operation and the most seaworthy type of fishing vessel.

The trawling operation is performed at low speed—3 to 5 knots—though not necessarily at low power, since the added resistance of the trawl gear not infrequently requires full power to maintain the necessary trawling speed. When the trawl is hauled aboard, the vessel is brought broadside to wind and sea with little or no forward speed, and the gear is hoisted from a point

well up the mainmast. This low speed while trawling introduces a factor which is, in fact, favorable to seaworthiness, since reduction in speed is nearly always helpful and often necessary when a ship is laboring excessively in a heavy sea. It explains why trawlers can often fish in comparative comfort in a seaway which would prevent anything approaching full speed operation. It is possible that the trawl net may have a steadying directional effect on the vessel's behavior not unlike the influence of a sea anchor. But as there is also a low limit of trawling speed below which the operation becomes ineffective, the objective is to extend the ability to trawl in heavy weather in order to gain fishing time. Likewise, of course, gains in ability to maintain speed on passage are desirable in a quite different speed range.

Hardy, Traung and Mökel say that the largest and most modern British and German trawlers—vessels of around 200 feet in length and 1,000 tons displacement with free running speeds of 11 to 13 knots—fish in winds up to Force 7 on the Beaufort scale (about 30 knots) and waves of about 20 feet in height from trough to crest in a fully developed seaway. They also report that the new German fisheries research vessel *ANTON DOHRN*—interestingly a steamer—which is fitted with a shelter deck, has fished in winds up to Force 8. These are most commendable performances, but they are a long way from being representative of smaller and older types which form the vast majority of trawlers at sea today. Each trawler is limited in ability to fish by some sea state which forbids maintenance of the speed necessary to tow the trawl gear.

A combination of factors determines the upper limit of speed in heavy weather; for the ship; size, the relation of displacement to length, hull form, and stability, for the sea; the relation of the length and period of the waves to the length and the natural periods of the motions of the ship. When these latter factors approach synchronism, the ship's behavior is most violent and its resistance most greatly increased. The problem is, what can be done to increase the safety and extend the upper limits of operational ability in both trawling and free running conditions?

Improvement of existing vessels is admittedly difficult. They are as they are, but some improvements may be effected. Stability characteristics may be accurately calculated and if advisable, ballast may be added or rearranged or even reduced. Loading and trim conditions may be improved and watertight integrity insured through well fitted hatches and other openings. But beyond these precautions, not much can be done to improve the seaworthiness and extend the operational limits of vessels already in service.

With the new design, there is much more latitude. For these small, "fat" vessels, V-type sections in the forebody, ample draft to insure good immersion of the propeller, and a moderate displacement-length ratio all have a favorable effect on seaworthiness and the ability to maintain speed in heavy weather. Ample freeboard and reserve buoyancy, particularly at the bow, are desirable. Sufficient transverse stability and easy rolling are somewhat conflicting requirements, but it may soon be possible and advantageous to incorporate such devices as anti-rolling tanks or adjustable fins which modify rolling without sacrifice of stability, which must, of course, be ample for all loading conditions.

Further than this, a rearrangement of conventional loading facilities which will improve watertight integrity is most desirable; systems which will obviate the necessity of open hatches at sea would contribute greatly toward increased safety. The problem of devising a subdivision of the hull of a trawler which

would afford some protection in the event of flooding or underwater damage, and yet would not interfere with essential internal arrangements is admittedly difficult, and it may be that no real solution can be arrived at until the trawler evolves into something quite different from the accepted type. But the possibilities should be in every designer's thoughts, for the vast majority of these small ships are indeed "no compartment" vessels which lose stability and buoyancy very rapidly when damaged or flooded beyond the capacity of the pumps. Engine room flooding is almost always fatal to this class of vessels.

All in all, the seaworthiness of trawlers presents some unusual problems which tax the ingenuity of the naval architect and the skill and seamanship of the master alike. In general, it is impossible to resort to much greater size, since first cost and operating expenses rise rapidly with size and out of proportion to increased earning power. We must look, rather, to the mounting knowledge of the factors which make for seaworthiness and the extension of operational limits and apply this knowledge to the peculiar requirements of the trawler.

The innumerable small craft which venture many miles from shore and fish in what for them is very rough water indeed also present a problem. What can be done to improve the seaworthiness of these boats?

Their design and loading must provide for ample stability and buoyancy. Possibly the most vital requirement for safety is that water be prevented from getting below, and that accumulations of water on deck or in the cockpit be cleared as quickly as possible. For this, ample and reliable pumps are required for the first emergency; low bulwarks or shallow cockpits with generous freeing ports or scuppers for the second. But the small craft depends for safety much more on the skill of the operator than does the well found vessel, and it is amazing what severe conditions a well designed boat can weather if she is truly watertight and skillfully handled.

Considerations of safety and efficiency lead to the question of design and construction standards and regulations. For new vessels, standards of seaworthiness can be developed which, if adopted, will greatly reduce casualties at sea and improve performance. The problem in design and construction is no more obscure with the fishing vessels than with the merchant ship. But to evolve such standards requires recognition of their importance and acceptance of skilled professional guidance. The naval architect and marine engineer must be given the same freedom and responsibility they receive in all other branches of shipbuilding. And there is no possible question that reasonable standards and to some extent, sensible standardization, would be of benefit to all concerned with the fishing industry.

These suggestions must not be interpreted to mean that fishing vessels should necessarily be brought under the full jurisdiction of governmental regulatory bodies such as the United States Coast Guard. On the contrary, such an eventuality would place an undue burden on the government agency and could result in regulations which would be unsuited to the fishing industry. What is needed is a voluntary engineering house cleaning on the part of fishing vessel owners and the evolution of standards appropriate to the well being of the industry. There are, at last, some faint signs that a more realistic attitude toward these questions is emerging, and indeed it is most fervently to be hoped that this is so.

But there is one field in which government regulation is more than ap-

propriate, and this is in the establishment of license requirements and standards for the deck officers and engineers on fishing vessels, for their abilities have direct bearing on the safety and performance of these vessels. The law which requires licensed officers above and below deck on almost non-existent steam fishing vessels seems to tolerate at great cost both unlicensed and often unqualified personnel on expensive and mechanically complex motor vessels. Again it is certain that the adoption of suitable license requirements would have a beneficial effect on the performance of fishing vessels, and on the cost of their insurance about which many complaints are heard.

The fishing industry should think hard and act wisely on these problems. A most significant step in the right direction was taken two years ago, when the meeting of the Gulf and Caribbean Fisheries Institute was joined with the first International Fishing Boat Congress here in Miami, at which technical and operational problems were presented and debated by designers, builders and operators together. It is to be hoped that that meeting was only the first of many to be devoted to this most important aspect of the fisheries.

It would be unimaginative to predict that present types of vessels will adequately serve the requirements for future fishing operations. Indeed it seems much more likely that as fishing is stepped up in intensity and complexity in many directions, the trend towards processing at sea will call for larger catches, longer voyages and bigger vessels. Nor is it certain that either ice or refrigeration will remain the best or most widely used methods of preservation of the catch on shipboard. But if the fishing vessel of the future becomes more and more a floating factory as well as a fishing ship, the combined operations will put an even greater premium on efficiency and safety. Such future vessels will call for somewhat elaborate facilities and operations approaching those of a shore based plant on the one hand, and a nearly continuously operated catcher on the other.

It would seem to the engineer that if the ocean fisheries are ever to approach their potential productive capacity, they must progress from the age old enterprise of hunting, even beyond the present and foreseeable stage in which detection of concentrations of fish becomes more and more positive. In effect, such progress would mean that some control could be exercised on the fish, and that, rather than relying on detection alone, the fish might be, in favorable locations and circumstances, attracted to the vicinity of the fishing vessel, and taken in quantity by methods radically different than heretofore. Successful methods of attraction and concentration, based on a wider knowledge of the habits and life cycles of desired species and of their ocean environment, could, it would seem, go far toward revolutionizing the fishing industry. If, as might also be conceived, sea food products should be developed which make use of a wide variety of species, something approaching mass fishing would be within reach.

What effects might be expected from such developments which would alter fishing vessel types and present new problems on the question of seaworthiness?

If the trend is to larger ships the problems of seaworthiness will be increased in importance, yet in a sense made easier. Increased size in itself will mean that the vessel will not be so continuously in relatively rough water; seas which to the conventional fishing vessel are large may become only moderate to bigger ships. Larger size will make the inclusion of anti-rolling devices far simpler. The question of suitable watertight subdivision will become at once more important and more feasible. Internal facilities may do

away with the practice of placing propelling machinery as far aft as possible, and the machinery spaces will become less vulnerable. Continuous double bottoms may be fitted more readily, and low freeboard in the waist may not remain a requisite to fishing operations. If in the future nets and trawls are not lowered over the side or towed astern, it is expectable that the design can be developed with far greater regard to seaworthiness; if the catch is taken aboard other than through deck openings, one of the greatest hazards in heavy weather will be eliminated.

In summary, it would seem to be expected that problems of seaworthiness of the fishing vessel of the future will submit to better solutions than do those of our present day vessels. And our knowledge of the sea and of the responses of the ship is steadily increasing and will soon be applicable to a degree which was hardly foreseen until very recently.

The Occurrence and Taxonomic Relationships of the Atlantic Blue Marlin (Makaira Ampla) in the Pacific Ocean

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Abstract

Evidence is presented showing that the blue marlin of the Atlantic also occurs in the Pacific Ocean and may be pantropical in distribution. Such evidence includes direct comparisons of specimens from the western Atlantic and eastern Pacific and a study of the literature. Species separation of the blue marlin from the other Pacific species is also effected through direct comparison of specimens as well as a study of the literature. Relationships are established by means of a natural key.

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The Modified Tuna Long-Line In Bermuda Waters

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Bermuda, situated in mid-ocean 650 miles from the nearest land, offers many things which are not readily available off a main land coast. Foremost among these is the fact that really deep water is within a few miles of the shore, and from some of the small harbors it is less than four miles to waters 1,000 fathoms deep. With these conditions prevailing, it was decided that experimental fishing with the tuna long-line might possibly uncover information concerning an unexpected offshore fishery.

The Bermuda plateau, or reef, has an area of about 300 square miles, to which may be added the two off-lying banks to the southwest, giving a total of just over 400 square miles of fishing bottom. This is not large, and with the ever increasing population (40,000 in 1950) the normal annual catch of 1,000,000 pounds of fish is not sufficient to supply the demand. A transient tourist population of 110,000 persons puts further demands on the industry. It is elementary to figure that further exploitation of the existing grounds could well lead to over-fishing, and, therefore, probably present a most serious problem for the future of the industry as a whole.

For a number of years the presence of such species as the blackfin and yellowfin tuna, wahoo, and blue and white marlin has been known but their potential not understood. In addition, the large bluefin tuna and the longfin albacore had been recorded on rare instances. No attempt to fish any of these species commercially had ever been made, though some good catches of blackfin tuna *(Thunnus atlanticus)* and wahoo *(Acanthocybium solandri)* were brought in by the game fishing boats. Seasonally, the yellowfin or Allison tuna *(Thunnus albacares)* had been observed in large numbers and in varying sizes, but very few could be taken by the normal methods of trolling.

It is highly probable that many islands in the Caribbean have conditions similar in many respects to those prevailing in Bermuda, and the main purpose of this paper is to tell of our experiment in Bermuda waters with this type of gear, giving a description of its make-up and approximate cost, along with some important data not usually considered in printed reports.

A modified version of the Japanese tuna long-line was prepared and used in Bermuda waters for the first time during May, 1955. As is frequently the case when fishing the open sea the results were surprising. This was evident even on the initial set of the line, made specifically for getting familiar with the handling of the gear. Two extremely large true, or long-finned albacore *(Thunnus alalunga)*, were taken on the first set. One weighed fifty-one pounds and the other fifty-six pounds. The large size of these albacore tends to indicate that there may be a heretofore unexpected fishery for a species which is usually associated with Pacific Ocean operations.

In order to have comparative data, the long-line was constructed with 100 hooks. Also, and most important for the local industry, the gear was assembled in a length that could be operated successfully from small craft, there being few in the business in excess of forty feet in length. The first set of the gear was made just before daylight, about four miles offshore, in approximately 1000 fathoms of water. The hooks in one basket were baited with garfish (balao) and pilchard in the next. The hooks were fished at a minimum of 21 fathoms and a maximum of 30 fathoms from the surface. The gear took one hour and forty minutes to set and three hours ten minutes to retrieve. This time has now been reduced to fifty minutes to set and about two and a quarter hours to haul.

Since we found immediately that tuna could be taken by long-line locally, it was decided that the next steps in the experiment would be to attempt to ascertain the types of bait most effective, the depth at which most fish were obtainable, and the effect, if any, of the moon phase, tides, and sea temperatures on the fishing. While insufficient sets were possible during the summer to form definite conclusions, (due to pressure of other work and the unusually early hurricane season) there are very definite indications of the following:

1. The best weather for catching fish is when the surface has a moderate

swell, regardless of the strength of the wind. A calm sea produces nothing.

2. The dark phases of the moon definitely produce more fish. The full moon period is the poorest, new moon the best.

3. It is apparent that baits fishing between 20 and 30 fathoms are the most successful in these waters. Shallower (15 fath.) and deeper lines were tried (40 fath.) but no catches were made at those depths. It was also found that setting in water shallower than about 750 fathoms was not productive, while from 1,000 to 1,500 fathoms seemed to be the best.

4. Best temperatures for fishing the open sea appear to be between 70 and 80 degrees Fahrenheit. It was found that temperatures are constant from the surface to a depth of at least 35 fathoms.

5. The following species of fish were tried as baits: pilchard (*Harengula callolepis),* round-robin *(Decapterus),* balao or garfish *(Hemiramphus brasiliensis*), anchovy (*Sardinella anchovia*), bream (*Diplodus*), grunt (*Haemulon*), yellowtail *(Ocyurus chrysurus),* and shad or mojarra *(Ulaema).* The only bait which caught fish consistently was the pilchard, and whenever possible the entire line is now baited with that species.

6. The duration of the set can be shortened if it is practicable to run the gear about an hour before low tide and pull it after about an hour of the rising tide. There are definite indications that a minimum catch will result from setting the long-line when an easterly wind is blowing. This, of course, would obviously not be the case in areas within the N.E. trade wind belt.

The experimental line had to be comparatively short in order to be stowed properly on the boat being used for the work. This craft is one which has been used at the Bermuda Aquarium for many years for the purpose of collecting live exhibits for the tanks. While there is more than sufficient room for hand-line fishing or fish trapping, the cockpit layout is not ideal for handling long-line gear. Overall length of the boat is 36 feet. The raised top of the fish well and the long engine cover considerably reduce the deck space. However, ten tubs of line, 100 drop lines, and the required buoys, flags, and ropes can be stored reasonably well, leaving some room on deck for the catch.

While excellent information may be had on this subject from Fishery Leaflets published by the U.S. Fish & Wildlife Service, I think a brief description of the make-up of the line might be useful.

The main, or long-line, is made up of ten sections, which are joined just prior to setting. Each section is carefully coiled into a galvanized iron wash tub, with the end to be attached to the next section coiled in first. The actual tail end of the line is left clear of the tub so that it may be attached to the other before all of the line in the tub has been run out. Each section of the line consists of 200 fathoms of quarter-inch diameter best Italian hemp fishing line, obtainable from the Belfast Ropeworks, Belfast, Ireland, at forty-one shillings per 130 yard hank, or about 1.25 cents (U.S.) per foot. Hard laid cotton twine of a suitable diameter will do equally well. At intervals of 20 fathoms a flag halyard clip is served to the line, to take a similar swiveled clip on the upper end of the drop or hook line. At the beginning of the line there is a float, with bamboo pole and flags attached as markers, and at each section or tub of line there is a similar float and marker, making a total of 11 floats for the 10 tubs of gear. If thought desirable, intermediate floats may be added in each section, but this is not essential.

The drop or hook-lines are 10 fathoms long, with another six feet of stainless steel cable of 3/32 inches in diameter on one end, and to which a size 9/0

Mustad tuna hook is attached. In order to prevent wear at the point where the line and wire are attached it is well to have chafing gear. In our case we use about eight inches of 3/16 inch inside diameter rubber hose which serves as a thimble in the wire loop. The loop is attached to an eye splice at the end of the hook-line. The wire is not spliced, but clamped with No. 18-2-G Nicopress Sleeves by a tool known as No. 51-G-887, as supplied by The National Telephone Supply Co., Cleveland, Ohio. We have never had a clamp pull out, and they are so much easier and quicker to handle than a splice. As all sections of the line are identical it is necessary to describe but one. Each is made up of 200 fathoms of long-line, ten 10 fathom long hook-lines, ten 6 ft. long wire leaders with size 9/0 hooks attached, one float, a 14 ft. long thin bamboo pole with flag attached to upper end, and a length of buoy rope. This latter rope governs the depth at which the long-line hangs. Ours are 10 fathoms long so that the main line sets in a horizontal position that far below the surface, and the hook-line and leader hang vertically another 11 fathoms, the baits fishing a minimum depth of 21 fathoms below the surface. Naturally, the long-line will not remain taut, and, therefore, through its sagging some baits will fish deeper. Sag may be kept to a minimum by increasing the number of floats. Several depths of hook-lines may be tried in one section. It is far cheaper to regulate the depth of the long-line by lengthening or shortening the buoy lines than by changing the lengths of the hook-lines.

One of the nicer features of the long-line is the fact that it lends itself so readily to modification. There are no hard and fast rules as to how it should be made up, or at what depth it should be fished, or the size or quality of the rope to be used.

Buoys or floats are very important, and consideration should be given to the type of fishing to be done before the selection is made. Wood is cheaper than most materials, but becomes logy with use and it does not float high above the surface. Metal floats are excellent, but it is quite possible that one or more may be crushed by the pressure of the water if they are pulled well below the surface by a large fish. The inner tubes of tires are also suitable. These also may be burst by the pressure of the depths if they are inflated too much on the surface. A pressure of about three pounds is sufficient. This will permit the air to become greatly compressed without too much danger of bursting the tube. One tube of a size used on a car or two of wheelbarrow wheel size, enclosed in old fish netting, make suitable flotation equipment. It is not necessary to have a pole and flag to every float, but one must be used at each end of the line, and sufficient between to enable the gear to be spotted at some distance. It is often possible to set the gear and leave it for several hours while trolling or setting traps, etc., but it is very important that the line be well marked and visible for at least two miles. Strong currents will move it at a considerable rate.

Generally, the strength of the wind will determine the direction in which the gear is set. In light winds it may be run either to windward or to leeward with equal speed, but in fresh winds it is more practical to set it down wind and haul it while going to windward. We have found no difference in results whether the line was run out straight or zig-zagged. The line may be patrolled so as to spot any float being towed or submerged, and the fish taken up immediately, or the whole left for a predetermined time and then retrieved. In most instances it will probably be found to be more practical to set the gear

down wind, leave it, and then begin the haul to windward, the first section in the water being the last to be taken out.

In hauling the line with the assistance of a winch or capstanhead it will have a tendency to twist. This may be kept to a minimum by hauling the rope in at an angle of about 45 degrees. The twisting of any one part of the line is not very serious, but that twist is generally enlarged so as to affect the hook-line as well, with the result that much time may be lost in the process of untangling the gear. The angled haul tends to keep the two parts of the gear separated until fairly close to the side of the vessel. If the upper portion of the hook-line is served with cotton twine for a distance of about six feet then the liability of entanglement is further minimized. Of course, fish will also make a shambles of the gear at times and there is no remedy other than patience while disentangling. In such instances it is generally better to coil the whole mess in the tub and clear the gear ashore next day, or later on deck. Sharks are also a problem at times, when hooked and when attacking a fish on the line. A sure remedy for this, if the shark is alongside, is a bayonet attached to an eight-foot pole. One or two jabs near the snout will usually take the fight out of the shark and then it can be handled with ease.

Shark trouble has been surprisingly small, only one fish having been mutilated during the whole experiment.

To date (October, 1955), the following species of commercially important fish have been taken on our long-line: blackfin tuna, yellowfin tuna, wahoo, true albacore, white marlin, and blue marlin. It is not anticipated that the catch of blackfin and wahoo will be great by this method unless sets are made over the continental shelf. These fish are generally taken in from 35 to 50 fathoms of water.

The largest catch consisted of four yellowfin tuna averaging 160 pounds, one mako shark, one blue marlin (82 lbs.), and one white marlin (80 lbs.), on a nine tub set of ninety hooks, using pilchard as bait. Twelve other baits were lost. This set was at new moon. The poorest results were obtained when the line was left out over night. There were three great blue sharks on the line, only one of which had been on more than a couple of hours. All other baits were intact. A total of four large albacore have been taken on four sets made in one area. These fish weighed 65, 56, 51 and 51 lbs. in the round. It is hoped that some intensive fishing may be carried out in this area in the near future with a view to ascertaining the potential of the albacore fishery.

The long-line is usually associated with large vessels, but with a little ingenuity almost any small craft can be utilized for the purpose. Under certain conditions it is possible to coil down the entire main line into one container. In the West Indies it will probably be far cheaper and better to use palm leaf baskets as containers for the coiled rope rather than galvanized iron tubs. They stow better and take up less space. Some of the Japanese lines are as long as twenty miles. Ours is only two and one-quarter miles in length. This does not mean that the lines have to be really long. In areas surrounding Barbados, for instance, where small boats are used to catch flying-fish, it might well be practicable to use a line of about one-quarter mile in extent and using about 25 hooks. In this area yellowfin tuna are frequently taken with live flying-fish bait, and it should be an excellent method of supplementing the annual catch. Such a line could be constructed for as little as £10, or about $27.50 U.S. currency. There would be no difficulty in hauling a short line by hand. Where a line is longer than one mile in extent it will be found more practicable to

have some mechanical means of retrieving the gear. A belt or chain driven capstan head, operated via a pulley from the main engine, is quite suitable. It is not even necessary that it be possible to disengage the "winch" when not in use, though this is preferable, of course. A simple roller on the gunwale of the boat will serve to minimize friction and, therefore, lengthen the life of the gear. This will apply equally to line hauled in by hand.

Experience is the best teacher, and it takes little time to learn that the line should be paid out over the stern, and hauled in from some point forward of midships. The latter makes it easier to keep head to the wind and swell, thereby making working conditions easier. Experience has also proven that the Japanese type of tuna hook is superior in holding power to that of our conventional hook. Due to the increasing demand for such a hook in the United States, O. Mustad & Son, Oslo, Norway, now manufacture this type in several sizes—from about 4/0 to 10/0. In ordering from them or from dealers elsewhere it is necessary to quote Qual. 9202, and the size required, in order to get the correct type. Size 8/0 is an excellent all-round size. It is small enough to get a 5 lb. fish, and strong enough to hold a 300 pounder. These hooks cost about 9d. (10c U.S.) each, for size 9/0, but are well worth the expenditure.

The cost of making up the 2¼ miles of long-line, 1000 fathoms of hook-line, all of best Italian hemp, plus the 700 feet of 3/32″ diameter stainless steel cable, 100 size 9/0 tuna hooks, 11 floats and poles with flags, and the 11 float lines of sisal rope, exclusive of labor, was about £100, or $280 U.S. currency. The labor entailed in making the splices is considerable, but in most fishing communities this can be done in a leisurely fashion during spells of bad weather. One set of gear, with reasonable care, will last about three years. Some wire leaders and hooks will have to be replaced at times, but the general wear and tear is surprisingly small. The rope should be well dried and stored in a ventilated spot if it is to be kept out of use for any lengthy period. Care should be taken to wash blood or bits of flesh from the rope before storage to minimize damage by rot or rats.

To sum up, the experimental fishing to date indicates that a successful commercial long-line fishery can be set up in Bermuda for yellowfin tuna, and possibly albacore. The industry will have to be introduced to this method of fishing and, should they be willing to accept the addition, the annual catch should be doubled, at least. The short run to the fishing grounds eliminates the necessity of expensive refrigeration, and it can be a one-day operation on each occasion. Within one year the experimental stage will reach its conclusion, at the end of which a full report will be rendered to the Government and copies of this will become available to all interested persons.

DISCUSSION

General Session

Discussion Leader: F. G. Walton Smith

Discussion Panel: E. A. Fieger, John Robas

The Effects of Chlortetracycline on Fish Freshness

M. C. Firman, A. A. Abbey, M. A. Darken, A. R. Kohler and S. D. Upham

Q. Fieger: What criteria did you use to judge quality other than the bacterial count?

A. Firman: We looked into all of the chemical tests that had been reported for quality of fish as an index of spoilage, and we felt that none of them was reliable enough or gave a constant enough figure for us to use as a mark of quality. In addition to bacterial counts we tested for odor, feel, appearance and sometimes taste. As we advanced along in this work we feel that we became a little better at judging.

Q. Fieger: Does Chlortetracycline have any effect on enzyme activity?

A. Firman: CTC slightly retards enzyme activity, but not to as great an extent as it is a bacteriastatic agent.

Q. Sturgis: Has your company done any work with menhaden, herring or other fish which sometimes come aboard at a rate of two or three tons per minute?

A. Firman: We have done work with menhaden and herring. We have come to the conclusion that on small lot work we can do a lot of good for the menhaden and herring industries. Our problem at present is one of engineering, of how to apply our material to 5,000 fish per minute coming aboard a menhaden boat. We are convinced from our laboratory work that we can do the job that is required. We are now in the process of attempting to work out the application.

Q. Robas: On the aureomycin work done on the menhaden around Fernandina in conjunction with your company, we noticed a pronounced golden color on the menhaden which were treated with aureomycin. Does this same golden color show on your edible fish, and if so how is the marketability of fish which show this golden color?

A. Firman: The color of CTC is in itself golden yellow. When we treat edible fish we do not use as great a concentration as this. There have been only occasional cases where one could see a slight yellowing of the fish. In most instances we have landed fish where the normal color is more pronounced. On cooking we destroy the aureomycin and therefore destroy the yellow color.

Q. Robas: What is the official attitude or policy towards the use of aureomycin in fishery products for human consumption?

A. Firman: At the present we have indications from Washington that they will permit us to do this in the not too far distant future.

Q. Brawner: If a commercial ice plant should adopt the method of putting the CTC in the ice to begin with would there be the possibility of getting too much of it and harming human beings who use the ice for other purposes?

A. Firman: Our intention, if we sell CTC to an ice plant, is to make ice only for fish, not for anything else. When the fish is cooked the aureomycin is destroyed.

Q. Brawner: How much will the amount of aureomycin for a 300 pound block of ice cost?

A. Wiley: The present cost can be expected to be $2.00 a ton more at 4-5 parts per million.

Use of Indole as an Indicator of Spoilage in Fresh Shrimp

James E. Alexander

Q. Fieger: Can indole be determined rapidly enough to be of value to the buyer?

A. Alexander: The total length of time should not exceed 90 minutes.

Q. Strasburger: Did you find that it was not necessarily the length of storage of the shrimp which was associated with an increase of indole but quite often such elements as exposure to heat prior to icing?

A. Alexander: In our experiments the shrimp were beheaded, washed and iced within a period of 20 minutes to a half an hour, so the exposure to heating was the same for all samples. I would expect that improper handling which accelerated spoilage would be reflected by a rise in indole count, independent of the time in ice storage.

Underwater Television in Commercial Fisheries Research

Reidar F. Sand

Q. Sturgis: Is there any chance in the future that aircraft might be able to spot fish in masses, either at mid or deep levels, through the use of television cameras?

A. Sand: At the moment we are interested in underwater television purely as a research tool to give us a more complete information on the fishing gear, bottom conditions and behavior of fish.

Q. Robas: Has anyone watched a purse seine being fished with underwater television?

A. Sand: To my knowledge, no. It is one of the things we plan to do. I do not believe that it would be much different from watching any other type of gear from a technical standpoint.

Q. Robas: Can the sound of shrimp be heard over the sound of propellers and if so is there any possibility that a shrimp vessel on the fishing grounds might be able to determine the presence of shrimp over the noise of propellers?

A. Sand: Not with the present forms of instrumentation.

The Occurrence and Taxonomic Relationships of the Atlantic Blue Marlin (Makaira ampla) in the Pacific Ocean

Luis R. Rivas

Q. Fieger: What are the possibilities of a commercial fishery on marlins in this country?

A. Rivas: The only part of the western Atlantic where marlin have been exploited is off Havana, Cuba. The possibilities of marlin becoming a commercial fish are very great. The Fish and Wildlife Service during their exploratory trips in the Gulf of Mexico and the northern Caribbean have been catching them in great quantities with long lines.

Q. Robas: Are these fish being caught for sale in Cuba as fresh fish?

A. Rivas: Yes. This has been going on for over a 100 years.

Q. Anderson: Do you have enough figures to give us a comment on the relative sizes of the blue marlin in the Pacific and Atlantic?

A. Rivas: There has been a great deal of controversy concerning the sizes reached by blue marlin both in the Pacific and Atlantic. The world's record blue marlin from the Atlantic taken by rod and reel is 743 pounds. Catches of blue marlin in the Atlantic run far above 1000 pounds in weight. With some commercial fishermen in Cuba years ago, a flag line was used and a blue marlin was captured weighing 1100 pounds. They have been caught in the commercial fishery of Cuba weighing up to 1500 or 1600 pounds. I have seen photographs of such a fish, and have measured the tail, which was saved. This enabled me to guess within 50 or 100 pounds the maximum size. As far as the Pacific Ocean is concerned, apparently the same sizes appear there. I believe one blue marlin was captured which weighed close to 2000 pounds, according to POFI.

Q. Hoover: What is the total volume of the fishery in Cuba? Also, what qualities does this fish have to the Cubans that make them pay 80 cents a pound for it?

A. Rivas: No official figures exist concerning the annual catch of marlin in Cuba. As to why it is so popular, there is no mystery in it. You can get a big steak from it which tastes very good. The marlin is a delicacy in Cuba and other places.

Long-Line Experiments for Tuna in Bermuda

LOUIS MOWBRAY

Q. Fieger: What is the availability of bait for tuna off Bermuda?

A. Mowbray: This is a problem, since Bermuda is an oceanic island. The bait is seasonal in abundance. If we find that almost any type of small bait will do for this job, then we shall have no further problem, for there are several species that would be suitable.

Q. Robas: Is there a possibility that we may have a potential long-line fishery for yellowfins for vessels leaving from ports along the U.S. coast, since Bermuda is only about 550 to 600 miles east of Charleston, South Carolina?

A. Mowbray: There is no reason to believe that a long-line fishery would not be good along a considerable length of the U.S. coast.

The Seagoing Requirements of Fishing Vessels

FRANCIS MINOT
(READ BY JOHN ROBAS)

Q. Fieger: Would you comment on the stability or seaworthiness of steel vessels versus wooden vessels?

A. Robas: There is no reason why well constructed and well designed steel vessels should not be as seaworthy or stable as a wooden vessel. The advantage of steel construction is that water tight bulkhead construction is much simpler in a steel boat. I would think that for a given amount of money a far more seaworthy vessel could be constructed of steel from the standpoint of water tightness.

Q. Wilmott: Do the larger New England vessels prove any better risks from the insurance standpoint than the smaller shrimp vessels operating off shore at present?

A. Robas: One surveyor does not see all of the boats nor does he hear about all of the losses, and Underwriter A who has six losses in a given period is reluctant to swap this information with Underwriter B. The present day shrimp vessel does not meet the demands of the situation. For instance, to my knowledge, 99% of these vessels have no watertight bulkheads. They are also still using pumping equipment which was designed for our inshore fleet back in 1945. We are sending 67 foot boats valued at 40 to 70 thousand dollars a long way from home with two pumps. They have one pump running off the main engine and a gasoline auxiliary pump. The gasoline auxiliary pump does not get very much use, the captain normally using the one running off the main engine because it requires no effort on his part to crank it. He rarely uses his gasoline auxiliary until an emergency arises, and

by that time the pump is a block of rust and will not crank, therefore he has neither pump. In an emergency his engine is frequently killed and so he may lose his vessel in a very moderate sea.

Q. Wilmott: Do you not believe that it is time for the industry to go to some technical advisory committee to develop a vessel that is suitable for operations further away from home ports?

A. Robas: About three or four years ago the Southern Shipbuilding Corporation, a division of the Gibbs Corporation in Jacksonville, decided to build some super shrimp vessels. These would be constructed to the specifications of the American Bureau of Shipping, would be surveyed as they were constructed, and if their construction and materials met the surveyor's approval they would be certificated. Provision was made for annual inspections and renewal of the certificate. They were constructed with double planking, watertight bulkheads, all diesel engine room with no gasoline auxiliaries and exceedingly strong construction. They were $45,000 to $47,000 at a time when a contemporary model shrimp boat could be bought for $30,000. They were sold readily, but the first two vessels were almost lost on their maiden voyages. They were grounded on a reef and were salvaged with difficulty, and brought home for rebuilding. The underwriters at that time took a short sighted view, and to my knowledge have never made any concession to these vessels in the way of insurance premiums; they have never given them a discount because they were safer vessels. They had an opportunity to encourage better vessel construction but did not do so. Subsequent to the initial two strandings, the loss record on these vessels has been quite good. Most of them, I believe, are still in service. Had the two vessels that went aground not been constructed with watertight bulkheads and with extra heavy construction they would have died on the reef, because they would never have been able to get them off and certainly would not have been able to tow them across 600 miles of open water to a safe port in Jacksonville.

Q. Whiteleather: From your experience as a marine surveyor, could you tell us what two watertight bulkheads in a present day shrimp boat fore and aft the engine room costs in addition to vessels not constructed that way? If it is only a few dollars difference percentage wise in the cost of a $40,000 vessel, why do they not put in the watertight bulkheads?

A. Robas: The extra cost of making present bulkheads watertight and keeping them up to standard pressure of water, would certainly not exceed $1,000 per bulkhead. The amount of wiring and piping that runs through those bulkheads is relatively small and all the pipes, connections and wirings have to be watertight as well, where they go through the bulkheads. This does not seem a prohibitive amount. The owner, at the time of placing his order, has to figure where he is

going to benefit from this and unless the underwriters are going to give him a little discount on his insurance or some encouragement, very few owners will expend the additional capital. If the owner would start it and the underwriters encourage it, eventually this would be standard procedure in the fleet.

Q. Taylor: The writer of the paper suggested that all of the captains, mates, engineers, and I suppose the deckhands too, should be licensed. If that were done how long do you think the American fishing fleets would operate?

A. Robas: I think that sometime in the next ten years it is going to be almost mandatory, because when you read some of the survey reports of statements made by captains and crew members, you wonder what that man was doing aboard the vessel which he lost. His lack of judgment, lack of skill, lack of elementary consideration for the rights of his owner, make it amazing to me that some of these people even find their way home. The underwriters, for example, have been advised that a certain vessel has been lost at sea and that the crew has been rescued. It is not uncommon in the Gulf of Mexico fishery for the underwriters to be prepared to pay off a total loss when the vessel has been found floating safely in the middle of the Gulf, with perhaps a foot of water in her engine room. The crew became alarmed at something in the middle of the night and just bailed out and left her and got aboard another vessel and left her drifting in the middle of the Gulf. Such men are not mariners, and some method should certainly be found to screen them. We have intensive control over the sport fishing captains who hire their vessels to sport fishermen—it is true that the license examination hinges upon the ability to fill out the application, but there is some control. I do not want to see the Coast Guard or any branch of the Federal Government come in and police the industry, but I believe that sometime in the next ten years someone is going to have to set up some standards as to what constitutes a captain of one of these vessels. I agree partially with what Mr. Minot says about the necessity for licensing of personnel, although I think that the licensing should be tailored strictly to commercial fishing.

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